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CYCLING AS AN AID TO HOME DEFENCE.

By Major-General Sir F. MAURICE, K.C.B., p.s.c., R.A., Commanding Woolwich District.

Wednesday, 22nd May, 1901.

His Grace the DUKE OF NORFOLK, K.G., A.D.C., Hon. Colonel 5th Bn. Northumberland Fusiliers, in the Chair.

I AM not quite sure that I ought not to begin by apologising for the title of this lecture. I do not think the number of people to whom I have to apologise is very great. We have just lately in the House of Commons had reason to think them few; but still there is a certain section, of whom certainly our distinguished representative of the Navy immediately before me is not one, who look upon it as an iniquity to talk about any form of land defence for England at all. We soldiers fully understand, one and all of us, our dependence on the Navy. I can answer for it, because I myself passed through a period when it was supposed to be an effective attack on me to say that I belonged to the Naval School, though I was a soldier. It was then discovered that I was not exceptional in that respect, because every soldier is of the Naval School in the same sense that I am, namely, that we trust the Navy for their share of the work. Nevertheless, most naval men themselves think that it is none the less our duty to have a second string to our bow; that the inhabitants of this island ought not to remain absolutely passive, great as is our reliance upon the protection given us by the Navy. They believe that we are bound to do something ourselves for our homes in order to provide against even a temporary lapse in the security which the

Navy affords. If we are to do that, I look upon it as certain that there is no cheaper way than that about which I am to speak to you to-day. I shall hope to develop that view in the course of my lecture.

I believe that about 13 years represent the time during which, as an actual military factor in England, bicycling has been used in our Regular and Volunteer forces. A long time previous to that a good many of us had had our attention directed to the importance of military cycling. My friend Colonel Balfour, who was my chief staff officer during the Cycling Manœuvres in Sussex, who is here to-day, gave recently a very careful history of all the previous attempts that had been made to use cycles for military purposes, so that I may refer to that and pass on. A great many people had a hand in bringing cycling to such perfection as we have been able to attain, almost all of them connected in the earlier stages either with the 26th Middlesex, which has been the special Cycling Corps, or with the London Scottish, of whom Colonel Balfour is the head. But during that time the cycle was treated as useful almost only for scouting purposes, and if it was used for anything else it was on a very small scale. We passed through a stage during which the cycle, as a means of military movement, was simply scouted. We were asked whether cycles could go across country, whether they could charge, and various other questions, hopelessly irrelevant to the point at issue, were put to its advocates. But I think it is safe to say that, although this Boer War has not for the first time taught the fact to many of us who have been much considering such problems, it has brought home to the English people at large the truth that the possibility of moving about an army, what we call "mobility," facility of getting to a given point in a given time, is one of the most important elements of warlike efficiency with every branch of the Service. It always has been important to be able to move armies with facility. In the days of Napoleon, and long before, it was true that "legs won more battles than arms."

But beyond all question the enhanced defensive power which has been given, to the infantry especially, by their new arms, and to the Army generally by the general change of weapons, has made facilities for the rapid transfer of force more important than ever. Rapid transference of defensive power became in the 1870 campaign an agent so important in offence that I do not think it is an exaggeration to say that the entire Regular French Army was captured and carried off into Germany because of the superior mobility of the German Army over the French, and the enormous defensive power which it exhibited, that is to say, that the capture of the French enclosed in Metz, and the capture of the French enclosed in Sedan, were phenomena so startling to every soldier who had been accustomed to the previous conditions of war, that they represented for us lessons which have been only re-enforced in the

present campaign. I suppose that everybody who has followed Lord Roberts' march from Bloemfontein to Pretoria recognises that it was to that extraordinary defensive power that he was able to trust in the case of the very slender forces strung out before the Boers. It enabled him to develop a large surplus on both flanks, and successively turn the Boer positions. The enormous extension would, even in the presence of such a force as the Boers, have been fatal had it not been for the present development of weapons. They would, much as it was against their habit, have been tempted to attack and break the slender line but for the defensive power of the rifle.

Now, there are certain conditions under which there is no agent for transferring force so effective as the cycle. The distance along good roads that the cycle can convey troops far surpasses anything that the horse can do. During the manœuvres in Sussex last year, some of the distances that were traversed by certain troops were startling. The 2nd Warwickshire Volunteers rode from Coventry to Hendon, a distance of 100 miles, on Saturday, August 4th. On Sunday they rode from Hendon to Cuckfield, a distance of 75 miles. Their ride from London had been in the rain all day, and they did not seem to be fatigued. One of their men went the same evening to Hurstpierpoint and back with orders, a further distance of 14 miles. It is obvious that there is no cavalry in the world which can touch that. They did excellent work on the Monday. The 1st Royal Sussex rode from Bisley to their billets at Burgess Hill on Saturday, and then acted as cycle orderlies all along the Billingshurst Cross Road to conduct detachments to their billets. The Cyclist Bearer Section of the Woolwich Companies of the Volunteer Army Medical Corps, on Saturday, August 4th, rode from Perham Down, 80 miles as the crow flies, to Horsham. They rode from Horsham to Cuckfield on Sunday, and then took part in the manœuvres both on Sunday and Monday. The forces from the South-Eastern District moved from Shorncliffe to the line of the Ouse, a distance of 62 miles in one day. Those are distances which represent the enormous facility which the cycle gives for the transfer of forces along good roads. In England we are in this favourable condition, that we have in all directions not merely good roads, but roads lying so closely together that in the Sussex district there were practically good cycling roads all along the line only three-quarters of a mile apart. It is tolerably obvious how great is the gain if you are able to deliver troops with that rapidity of movement in such numbers as may be moved along many roads along a wide front. There were 24 miles at the particular point where I was trying it, with roads throughout leading to the front within three-quarters of a mile of one another. As the country between the roads is for the most part of a peculiarly defensible quality, if you are able to move even moderately large numbers along each of

the several roads, you would have in the aggregate a force which it would be extremely inconvenient for an enemy to ignore.

Therefore, I think that if there are obstacles in the way of creating Cycle Corps, it is worth while to remove them. Looking at the large question of the defence of the kingdom, I cannot see that there is any doubt that one difficulty we shall always have will be that of gaining time. If we can gain time we shall always be able with ample resources to meet any force that lands. If it be possible, wherever an enemy lands, to do what we were able to do at Brighton, namely, deliver forces from a distance of at least 150 miles on either flank within striking distance of an enemy's landing by means of the cycle before he is ready to meet them, then in such enclosed country as we have in England, having available men who know all the different districts perfectly, we shall be able to impose a delay which would most seriously hamper an enemy. I said in my report on the Cycle Manœuvres in the Brighton district last year, that I feel perfectly convinced, from what we were able to do; that no Army pushing up in that district—and it is very much the same as most other districts in England—would have been able to advance against the force which could be delivered by cycles alone, at a more rapid rate than 4 miles a day. If we can enforce that delay there is plenty of time to get ready a striking force; even if we are almost as denuded as we were last year.

There are unquestionably certain difficulties in the way of cycling development in England, and the first of them is that curious conservatism with which we in England receive anything that is new. It applies to us all. There are two stories with which I am fond of illustrating that point. Some of you may have heard that when Sir Walter Scott was staying in London on a certain occasion, he wrote to a friend in Scotland, in language rather more expletive than I should quite care to reproduce to the effect that "There is some horrible fool here in London who is actually proposing to light the streets of London with gas, and what is yet more amazing, there are some other yet more absolute idiots who are going to let him try his hand at it." You all perhaps know that Lord Derby, the Premier, undertook to eat the boiler of the first steamer that crossed the Atlantic. Those were two perfectly representative men. They were neither of them men more lacking in common sense, to use the mildest term, than any of us. Sir Walter Scott and Lord Derby are not names to be treated with contempt; and if they were capable of that sort of resistance to anything new, I think it is tolerably safe to say that that is a national characteristic which we have to recognise. It always has been so and always will be so, and many of our most valuable national qualities have been born of that sort of conservatism; but, as we are feeling in all the commercial relations of

life, our kinsmen across the Atlantic are running away from us because they meet novelties in exactly the opposite way, and do everything they can to encourage anyone who has something new to bring forward, provided he will have it tested and tried. I think it is necessary that in all cases, not merely military, we should "wake up" to recognise that the world does not stand still, that we must move, accept situations as they arise, and face them under the conditions of the day.

Then there is another difficulty, which I can best express by saying that we all of us have our Little Pedlingtons, and that we all want to heave half a brick at anybody who lives outside. I do not think that is altogether peculiar to England. There is a very great difficulty when any quite new thing has to be started, that all those who are in possession of the field in other ways think it their particular business not to help it along, but to heave a brick at it. It was so in a measure with regard to the Volunteer force when it first came into existence, but it has none the less proved to be of the greatest assistance to the Army, even if—which is certainly not true of it—in nothing else, then in awakening the patriotic enthusiasm of the country, and that patriotic devotion of which we have had such splendid examples during the last year, and in assisting in obtaining for the Regular Army such development as it has had. But what I want specially to insist upon is, that if we are going to utilise any new force, then we cannot put it into a Procrustean bed fitted exactly to our own previous impressions and prejudices, and say "You have to exactly lie in this, or you shall be split from top to bottom." With regard to any force that is employed outside the Regular forces, you must take account of the special conditions which will enable those who wish to help you to do so. I mention that particularly for this reason: I have hitherto spoken only of the manœuvres in Sussex last year, but just lately there have been some other Cycle Manœuvres, those at Easter, and the purpose for which I now mention them is that they illustrate this difficulty, because the conditions which are necessary for any Volunteer force to be able to co-operate in any work that has to be done were (I doubt not from accidental causes) not taken into account before the Volunteers were called on for those manœuvres. My experience in Sussex showed me, as one might have known beforehand, that it is necessary to give Volunteers ample time in order to make the arrangements which are necessary to enable them to contribute their patriotic assistance and make the sacrifices they have to make in order to be ready to give us help. I should have wished very much that we could have had this year some further cycling manœuvres, but I am quite sure that, though it may be desirable to try the cycles further on a small scale again this year, yet, for anything on a large scale, it is necessary to wait until next year, because if you try to arrange for any combined manœuvres of Volunteers you must give each Volunteer

time to settle beforehand with his employers. Even during the Brighton manœuvres, although we tried to give the earliest possible notice, we found that a very large number of Volunteers were unable to attend because their plans had been already fixed. As a rule, I think it is tolerably safe to assume that a year's notice ought to be given if you expect to get any large number of Volunteers away from their employers for a particular day in the year. The different Volunteer organisations usually find it necessary to make their arrangements a year in advance.

Then we have had lately brought before us the question of rifle clubs. Certainly I should be very sorry indeed to pour cold water upon the efforts of a number of individuals all over the country to make themselves good rifle shots. I think the more good rifle shots we can get in the country the better; but it is perfectly certain that the mere fact of their making themselves into rifle shots will not enable them to become adequate defenders of the country, and that, in some respects, the formation of these different "town guards," of which we have heard, tends to propagate amongst the civil population of the country a most dangerous idea of the mode in which England can be safely defended. I found when I went to a meeting at Birmingham of the representatives of the nascent rifle clubs, that the moment I suggested the question of their using cycles in combination with their rifles, in order that they might transfer their forces to the points where an enemy was actually landing, or was likely to land, the answer was: "Why should we from this very populous district of the North and the Midlands move down for the defence of London?" If it were only for that reason alone, merely to get into their heads the fact that if we want to defend England we must meet the enemy wherever he is, and not attempt to oppose to him a defence scattered all over the country, it would be an enormous advantage to us, to persuade them to use a means of mobility with their rifle. The attempt to combine the cycle with the rifle tends to make people realise that they are wanted to move, and not merely to stand still, and for that reason, if for no other, I am very much inclined to urge rifle clubs, wherever they are, to form themselves into cycle clubs at the same time that they form themselves into rifle clubs. As soon as they do, I am quite sure they will also find that that implies unity of action and co-operation amongst themselves. The element of discipline will then be seen to be essential to the work which has to be done.

I venture to suggest that there is some danger—not certainly in this audience, but in the country—that the experiences of the present war may in this respect mislead. There is an impression abroad, because we have found it extremely difficult to dispose of the resistance of a number of Boer farmers, that therefore, if we can only get a number of English riflemen all over the country we can very considerably improve the

defence of England. Well, I think there is one simple illustration that may bring pretty effectually home to the minds of the nation that that is scarcely so. There was a time when a great financier had the question put to him, "What would happen if the Bank of England was occupied by a foreign Power?" His famous answer, "That must never be," is obviously true. He meant, that supposing that that were to happen, it would be a stroke at the very centre of our whole commercial life, and would be practically the death blow of England, or at any rate a blow from which we should have incalculable difficulty in recovering. What I want to suggest is, that nothing the Boers have done throughout this war has for more than a relatively short time prevented our Army from going wherever it wanted, that it has marched into Bloemfontein, into Pretoria, and into other places wherever it required to go. Therefore resistance, such as that made by the Boers, would not have protected the Bank of England from the invading Army. On the other hand, I think it is necessary that we should realise that we may obtain very great value, at least for delaying purposes, out of a body which is something other than a rigidly controlled military force. If we can get sufficient unity and sufficient co-operative action among a number of men who can take advantage of our close country to impose delay upon an enemy, it is sufficient for us without their being under precisely the form of unity which we find necessary for soldiers. A Regular Army requires a form of training much more rigid than is needed for a body that is merely intended to impose delay and to hamper the movements of an enemy, and such a body might be created, composed of men who could not give up their time even to the regular infantry drill of the Volunteers. My view of the case is, that we want people, whom I should like to call Cycle Riflemen, drilled so far as to be able to move in tolerably close bodies on their cycles along a road, but, so far as their actual fighting is concerned, trained chiefly to take up positions in comparatively small numbers and to fall back under the protection of other forces of the same kind, or to surprise an enemy by appearing suddenly on his flank, and to do other similar work of that kind. All the drill necessary is to enable considerable bodies to move in a concentrated form along a road. Everything else is a question of actual tactics of such a kind as they would be very much interested in and enjoy, and such as could be carried out in a comparatively small number of days in the year. At all events, I can give my own experience that the very first day I tried a number of civilian cyclists at Woolwich, with the co-operation of Captain Barclay and of certain non-commissioned officers of the 10th Hussars, who worked with them, the following incident happened. I had detailed a captain of infantry, with a company as strong as it could be made up, to halt on the east side of Shooter's

Hill, on the road leading to Blackheath. He had thus to move over a hill directly westwards into Blackheath. Soon after the crest of Shooter's Hill is reached, the ground on either side of the road opens out into woods and cover of a pretty marked character. I told the captain that he would find himself opposed by a number of cyclists partly in civilian clothes and partly in uniform. They were, in fact, some of the cyclists of the 10th Hussars, and some of the cycling clubs who had been trained by the Hussars. I further told him that he was to take as his signal for beginning his movement for forcing his way on to Blackheath, where he was to sleep that night, the fact of a certain number of cyclists appearing on the crest of the hill, and some of them beginning to shoot at him. Shooter's Hill is particularly steep: the ground westward at the foot of it is level, and a little beyond where it becomes level the main road is crossed by a road, one branch of which goes south to Eltham, and the other branch north to Woolwich Common. The cyclists who were to carry out the manœuvres against the infantry company were divided into three parties—Reds, Whites, and Blues. Their orders were that, as soon as the infantry began to advance against them, they were to come down from the top of Shooter's Hill, as hard as they could ride, down the Shooter's Hill Road, till they reached the cross-roads. There they were to divide. The "Reds" were to go straight down the road, and take up a position at the end of the straight part of it. From thence they could fire straight up the road down which the infantry must advance. The "Whites" were to swish round to the left, that is, to the south, where they were to drop their cycles at an assigned corner, and take up a position from which they could, in concealment, fire upon the Shooter's Hill Road from the south. The "Blues" were similarly to move north to Woolwich Common. The cyclists came rushing down the hill as soon as the infantry captain advanced against them. As he saw the cyclists running away from him he thought he had nothing to do but to push on and pursue them into Blackheath. The consequence was that when he came half way down the hill and was fairly within view of the cyclists in concealment, they fired straight into his column of fours after letting the advance detachment pass them. I do not think many of the company could have escaped. I had been watching at the corner to see what would happen, and I rode up to him and asked what he had been doing. He told me the story that I have told you, that he thought he was only pursuing, and had therefore taken no precautions against what had happened. I said, "For goodness sake, get your flanks properly scouted now." He threw out his scouters, to scout for the cyclists who were in cover on both sides of the road. The dismounted cyclists slipped away and mounted their cycles at the point where they had left them, but perhaps remained a little too long. The

Herbert Hospital is at the corner where the cross-roads I have described meet. Behind it, parallel with the main road, there is a by-road. The "Whites" were able to slip down this side road quite out of the fire of the infantry pursuing them. The infantry had seen them go that way, and followed them down. Half of the infantry company went that way and the other half on the other side, north of the Shooter's Hill Road on to Woolwich Common. The southern half company followed the cyclists down the by-road. The cyclists on the main Shooter's Hill Road, the "Reds," finding the road now clear, advanced along it, and passing round the Herbert Hospital slipped behind the infantry. The whole of this half company were thus encircled in a fire which they could not possibly face, and from all I could hear on all sides, very few of them would probably have escaped on this second occasion.

What I suggest is, that a few simple manœuvres of that kind could be very easily practised. I had, a quarter of an hour beforehand, told Captain Barclay, the officer of the 10th, who had been working with these cyclists, exactly what I wanted him to do. With very little instruction, and instruction which it would be easy to give, such as they would greedily receive, it would be quite possible, with the very intelligent men whom I have found among the cyclists, and as I think, as a rule, the body of cyclists are, to make them a very awkward force for any advancing body to despise, as they were despised by the infantry on that occasion. They could make themselves in the highest degree inconvenient, to say the least.

It has been my fate to carry out examinations for promotion of somewhere about 100 officers during the last few years, from major to lieut.-colonel, and for many years past I have almost invariably thrown in a pinch of cyclists to be dealt with if I possibly could. I generally find that the fact of having cyclists to deal with is an excellent test of an officer understanding his business, partly because the question has not been thoroughly considered in its various aspects. Many officers have never thought of the problem before, and it comes as a novelty to them. Some of the mistakes that are made are funny beyond description.

I have had cavalry screens sent out in good fan fashion, right through woods held by cyclists, simply because that was book formation for a blank sheet of paper or imaginary ground. I do not know anything more useful than cyclists for testing the work of other arms. The other day I told a body of infantry, under a very excellent lieut.-colonel, to take up a defensive position round Woolwich and to put out outposts all round. I sent the cyclists to attack the different outposts. Of course it was not at all a fair test for the cyclists, because if you know that you must be attacked at a certain place and within a narrow margin at a certain time, reasonably good arrangements will provide against it. The

outposts were remarkably well put out, and I do not think the cyclists would have had a chance of getting in; but I am not at all sure that if for four or five days, at uncertain hours, I had kept on harrying the outposts with a number of cyclists, the army under their protection would have slept quite so safely. If they had been kept awake they would hardly have been quite so fresh as they would have been without that difficulty. Therefore, I feel tolerably sure that for this purpose also a body of cyclists could be trained to be a very useful worry, to put it at its lowest, to any enemy that was engaged in moving up through England.

On that account I am very anxious indeed in fixing the terms on which we try to get together large bodies of cyclist riflemen, that we shall make those terms suitable to the kind of work that the riflemen have to do, and that we shall not tie them down to the conditions we should assume for Volunteers under other circumstances or for Regulars. Nothing can be much worse than regulating your cavalry by infantry rules, or your infantry by cavalry rules, or your artillery by the rules of either. Cyclist riflemen require to be dealt with in accordance with their conditions just as much as the other arms require to be dealt with according to theirs.

The next question is how far you can use large bodies of cyclists. I can only say that I think we had a very fair test in the cycle manœuvres last year. I have gone into that question fully in my report on the manœuvres, and therefore I do not want to do so again. We could not, with the numbers we had, attempt to represent in the same operation the combination between considerable numbers on one road and similar numbers on another road, but we could, by taking the two points as separate problems on different dates, show on one occasion how we should keep up the connection between different roads, and so long as we could keep up that connection and make the movements simultaneously, it did not much matter for that purpose how many there were on each road. Then we put the whole together on a single road to see how many we could work on each. The conviction to which I came was that you could certainly work under the conditions which I propose, with bodies of 1,000 to 2,000 men along the roads, and that you could keep up the connection between them perfectly safely under the necessary conditions, that is to say, that you should have a connecting cross-road both behind and in front of your cycling bodies, and under those circumstances you could deploy between the roads a very valuable force that would give great trouble to an enemy advancing.

Then as to the experience that we derived from them in other respects. There is much to be said about many points, and I should be glad that anyone here who has not seen the report would take the trouble to look at it, so that I may avoid repeating what is discussed in it. But the most interesting experience I myself obtained was the extreme useful-

ness of the body of cyclist Volunteer officers who worked with me. I had a most valuable staff entirely composed, so far as the actual cyclist working was concerned, of Volunteers. My special reason for mentioning that at this moment is that I have here a paper to which I wish to draw attention, because it represents a piece of Volunteer officers' work that I think is too good to be lost sight of. I am not at all sure that there are not many things in it I should treat differently, and should want suggestions upon, but for a piece of thoroughly good military work I think it is as good as it can be. It is about 29 closely-typed pages on the general question of the supply of ammunition for cyclists, the organisation of cyclists, and the clothing and equipment of cyclists, all worked out by Mr. Newington, who was with me as a staff officer during last year's manœuvres, and I hope to hand it over to the Institution so that it may be reproduced. Mr. Newington has now gone to South Africa, where I am sure he will be a very valuable officer.

In the scheme which has been worked out by Mr. Newington I think the basis is laid down of what might be a very valuable force in England. At this moment we have about 80 companies of the Cyclist Volunteers, which will represent, when they are properly trained, a body of 6,000 men which would be extremely valuable. On the principle Mr. Newington has suggested of working local detachments all along the coast, with others in the towns behind them co-operating, I think much more could be done. If encouragement were given to the million cyclists we have in this country now to submit to training, we should have means of delivering at any given point a very much larger body than anything we have yet attained. I believe you could work a body of something like 100,000 men with cycles, on a front where there are a sufficient number of roads, and that they could come in from all directions, North, East, and West, from great distances, to meet any landing that could be made. With that you must have organisation for the supply of the men, and for that I am tolerably convinced you must combine cycles with motors of all kinds. We did that to some extent and it worked successfully.

In the hall you will find sundry things which will interest you. There is Colonel Wallace's equipment, which supplies a means of furnishing ammunition to the cyclists, the best I have ever seen for the supply of infantry in the field. We are able by means of it to get ammunition close up to the fighting line without any trouble at all, by the cycles, and the very equipment in which the ammunition is carried on the cycle can be handed to a man on foot for its actual distribution. There is also a portable boat carried on cycles and the new model of the government cycle.

Finally, I have only to thank you very much for the kindness with which you have borne with me. The one thing I want to suggest is that

we must accept the best help we can get from the patriotic enthusiasm of the country, and not look a gift horse too closely in the mouth. We must take him as we can get him, and put him to the best use of which he is capable.

Lieut.-Colonel E. BALFOUR, commanding 7th V.B. Rifle Brigade (London Scottish) :—I find myself somewhat in a difficulty in speaking after General Maurice, because I was acting as his chief staff officer during the cycling manœuvres which he has partially described in his lecture; but as will appear presently, there is only one very small matter in which I can possibly find myself differing from him, and on that I know he will excuse me stating my views. I cannot say what it means to anyone like myself, who for thirteen years has been studying to get military cycling recognised as a proper arm for home defence and foreign war, to find such an officer as Sir Frederick Maurice assisting it. I do not want to go into the question of the Navy and home defence which he touched upon, because it is my misfortune to have to give a lecture here towards the end of June to the Army League, in which that will have to be dealt with; but there are one or two points on which I might be allowed perhaps to supplement his lecture from my practical experience. The first point I should like to press is one I know my friend Colonel Hale will endorse, viz., the extreme variety of the pace at which military cyclists can go under varying conditions of wind and weather. To every arm of the Service I take it there are objections. Artillery can do this sometimes; they cannot do it at other times; a traction engine may cross a drift, while an ox-wagon may not be able to do the same thing. Therefore everything has its objections and everything has its merits. The real objection to military cycling—and I am a great advocate of it—is the uncertainty of speed. That uncertainty of speed acts in a double way, because, to start with, you have in military cycling an enormous extension from front to rear along each road. That enormous extension is altogether unimportant if rapid concentration is possible; in other words, if I have 2,000 cyclists marching along one road, and I take a yard a man or two yards a man, say 4,000 yards, if those men can close up in a short time they are a sound military body, but if the pace is such, as happened in Essex, that the head of the column, and therefore the tail of the column, could go only 2½ miles an hour, that force cannot concentrate at once. It is a matter of time and space combined, and they act and re-act on each other, and it has to be considered most carefully and to be overcome. It can be overcome. To my mind it is no use minimising the disadvantage of any arm. The great thing rather is to exaggerate it so that the general in command of that arm may be able to know what the worst will be and what the best will be. On Saturday last I was marching in the Wolseley Cup Competition. The distance was one of 40 miles, and the teams 8 men each. They had to ride the 40 miles in four hours, but the conditions were favourable and they rode them in three. There is another point which the lecturer did not touch upon, perhaps because he is not a Volunteer commanding officer, and that is the astonishing regulation which the War Office has issued that no grant is to be given to Volunteer cyclists until there are 60 men in each company. In other words, if I have 59 men I get no grant; if I have 60 men I get £2 a man. It is inconceivable, but it is a fact. The point on which I really have to differ from Sir Frederick Maurice is the question of rifle clubs. Day by day when I drill my men, when I see hedgerow fighting and when I find out what it really all means, I see the absolute necessity of a system—the simplest that you can get in the world—but a system of rigid drill which can be applied in the field. I do not see how to get it out of the system suggested by Sir Frederick; honestly I do not—I wish I could, but I do not see

it. I think there was a little breakdown in our manœuvres. Hedgerow fighting seems to me more peculiar than any other fighting in the world, requiring more preparation, quiet drill, and the more you are going to practise the attack in wide order, the more necessary it seems to me to have previous practice in carrying things out; and the more intricate the country, that is to say the more hedgerow fighting there is, the greater seems to me to be the necessity.

Major-General Sir FREDERICK MAURICE:—We are not at issue at all. It is only the book drill, which I do not think necessary. I think you must multiply your practice in order to avoid the book drill.

Lieut.-Colonel E. BALFOUR:—There is another very interesting point which we discussed very often, and I confess is very hard to decide, and that is the question of leaving cycles behind. It is a question I fancy myself to be decided in each case, but it requires very careful thought beforehand and requires training for the individual captain to know when he shall leave the cycles behind and when he shall take them on. I just want to tell you one little story of how cyclists may blunder. It was a night attack on Coulsden Common, near Caterham, and I had infantry only. I knew my enemy had a body of cyclists. I told my advance guard to take off their white spats and hang them on their backs so that each man could see the man in front, and then they were to walk in the ditch. They passed the whole of the cyclists on the way, closed upon them and captured the whole of them. There are just two or three points, if I am not trespassing too much upon the audience, I should like to mention. Sir Frederick has mentioned one or two of the tactical employments of cyclists in resisting invasion, and I think I may ask him in reply to suggest five or six more. One he suggested was a great turning movement against the enemy's communications and acting with rapidity, and I think it is very important that this should be impressed on the public. He has frequently alluded to an officer of my corps, Mr. Newington, who was previously Captain Newington, of the Cambridge University Volunteers. Mr. Newington is now in South Africa. A subject which deserves attention, I think, is the rifle attachment, and the Spark-Brook Factory has an extremely good mode of one, which I think the lecturer mentioned in his report.

Colonel LONSDALE HALE (late R.E.):—I speak with some alarm on the present occasion, because I remember some years ago in the old building, when the lecturer was sitting on one side of the theatre and I the other, the lecturer got up and said: "I have listened to Colonel Hale several times in this theatre, and I have never known him speak without his finding fault with something that has been said before." I am going to put before you rather a different view of the use of cycles in the defence of this country from what Sir Frederick Maurice has submitted this afternoon. I think if he formulated his views and took them to the War Office and said "I want to use these 100,000 cyclists, or 6,000, or whatever it is, to stop the landing of an enemy and to delay the advance of an enemy," it would be a good many years before the War Office digested that idea and accepted it. It would be a little bit too novel to them, and there would be a great many cons and very few pros put forward. In this question of the use of cyclists, experience does not tell us much, because the whole subject is new; but those who have followed wars and studied military history cannot but agree that the theatre of war in England is singularly suited to the use of the cycle, and that if we had in this country ten battalions of infantry, 1,000 strong, each capable of transporting themselves over abnormally large distances in an

abnormally short space of time, that 10,000 men would be a very great factor in the defence of this country. I want to lift, if I can, this question away from the low level in which it stands at present, a low level caused by our small experience of cycling, and dealing only with small bodies. We know little about cycling in large bodies. We had a very good trial in Essex, but still not on the scale that is desirable. There are two points which I must insist upon with regard to any trials by cyclists; two things must go hand in hand with cyclists in masses: one is intelligence, and the other the very strictest discipline. It is all very well to talk about a little drill or a little discipline. Nothing of the kind! I went careering over the country in Essex on a motor, and it came to my mind how important discipline is, and how impossible it is to get on without it. I am not talking of officers, but of non-commissioned officers. We know in all Armies in the world the maintenance of discipline by non-commissioned officers is difficult, and still more difficult must it be in the Auxiliary forces: but in these cycling manœuvres you leave a body of men and in 5 miles you see nobody at all, and then you come across a small party perhaps under a non-commissioned officer, and then there is another 5 miles before you meet anybody else. And unless the men will be thoroughly well disciplined and obey their non-commissioned officers as well as their officers you will come to grief. I am perfectly certain from what I saw of the cycling sections in Essex that you can get 2,000 thoroughly disciplined and well-drilled cyclists from the Volunteer forces. You must have them well drilled, and Colonel Balfour agrees with me there. There is the simple matter of mounting the cycle: that is drill. I saw a battalion coming from Chelmsford after a 5-mile ride from Bishops Stortford, and I asked the officer how they had got on. He said "Very well, but the nuisance is that some men do not know how to mount. A man who cannot mount his cycle will throw the whole of the column into confusion, and cause an immense amount of lengthening out." There was a team at Bisley the other day, a team which mounted like a German regiment on parade. There must be thorough drill in connection with cycling. But do not let us think of cyclists as patrols, reconnoitring, or performing tactics of their own. They are simply infantry, and are to be used as infantry, and they must regard their cycles merely as a means of getting along quickly. Do not tumble into the old hole into which Colonel Hutton and his infantry tumbled. Do not let us pretend to do what the cavalry can do much better. Let us regard this force, which will play in the defence of this country a certain important part, simply as a large body of infantry soldiers with means of getting along faster than the ordinary infantry soldier.

Lieut.-Colonel C. M. DOUGLAS, V.C., M.D. (Hon. Brigade Surgeon, retired):—I must apologise for appearing somewhat in the character of the shoemaker going beyond his last, in addressing you, but my cycling experiences have been somewhat exceptional. Since 1869, when I began riding on a bone-shaker at Secunderabad in Central India, I have cycled almost continuously up to the present day, so that I can say something as to the capabilities of the machine in helping this work of concentrating forces. As Colonel Hale says, it requires time and trial. Perhaps we may make mistakes: we may occasionally take a wrong road. In the Eastern tale, the patient asks his physician: "Why do you give me medicine for my eyes when I am suffering indigestion from having eaten burnt bread?" "I give you medicine for your eyes," replies the physician, "that you may see better than to eat burnt bread again." So the eye-wash that is given us for having taken a wrong course helps us to see what is right. There is one point I should like to call attention to, and that is, the possibility of cyclists being used to repel isolated attacks on our coasts by armed cruisers, torpedo-boats, etc. The

possibilities of these attacks I think cannot be overlooked if we were at war with a foreign Power. Towards the end of the eighteenth century that unpatriotic Scotchman John Paul (alias Paul Jones) succeeded, I believe rather successfully, in harrying the West Coast of Scotland, and the East Coast also. A little later than that, Sir Walter Scott mentions in his story of the "Antiquary," the consternation that the town of Fairport, St. Andrews, I believe, was thrown into by the reported appearance of a French cruiser in the offing: how the Yeomanry flocked into the town as fast as they could to help in defending the inhabitants against the landing from this cruiser, and, of course, devastating the place. I believe some little manœuvres might be easily arranged to exercise the Volunteers to repel such attacks. I am sure they would gladly give their help, and it would not cause a very great inconvenience or difficulty. That is one of the points I wished to mention. I should like to have said a few words as regards the use of folding cycles for scouts, but those are matters of detail which I believe are extraneous to the lecture. If I could lend any little aid to help to produce a scheme to forward the movement I should think myself fortunate.

Major-General Sir FREDERICK MAURICE, in reply, said:—I may have been wrong about the nature of the wind difficulty in the Easter manœuvres, but those manœuvres seem to me to bring out very forcibly the point that, with a force able to afford to make such a very large circuit as a cyclist body can, it ought to be one of the points to take into account that you should try to get to a position from which you can move down wind during the critical period, instead of up wind. I do not want to criticise the man who was in command, and am only considering it as a cycle study for future use: but it does seem to me to be a distinct point in cycle tactics, that if you are going to attack from north to south, and the wind is from the east, then you should attack from east towards south. If the wind is from the west you should attack the other way.

Lieut.-Colonel E. BALFOUR:—I tried to enquire about that. Colonel Hale was there, but I was not. As far as I can make out, one of the causes of failure was the excessive speed attempted under adverse conditions in the morning, and the men broke down and could only do the 2½ miles an hour later on. I cannot, however, give that as an authoritative statement.

Major-General Sir FREDERICK MAURICE:—My point is that, in nine cases out of ten, if you are going to make an attack from the point A to the point B you will usually have your choice of making that attack by going very nearly down wind or up wind, and it is worth while cyclists sacrificing a great deal to go down wind rather than up wind. For instance, to take the particular case mentioned by Colonel Balfour; the attack was from north to south, and the actual attack was made up wind because the left flank was attacked. If the right flank had been attacked, it would have been down wind.

Lieut.-Colonel E. BALFOUR:—Exactly in the same way as my motor-car driver now prefers to go 6 miles round to 2 if he can avoid a hill.

Major-General Sir FREDERICK MAURICE:—Just as the wind is an extremely important thing in a naval action, so it is an exceedingly important thing in a cycling action.

General J. H. DUNN, Colonel the Duke of Edinburgh's (Wiltshire Regiment):—Surely the commander of the force must get to know the exact rate of pace his cyclists are able to go up wind and down wind, and if he does not make quite sure by practice, as Colonel Hale says, and by perpetually working it out beforehand, he

may be in a tremendous hole if his cyclists only went 2 miles an hour when on another occasion they could go 20 miles in three hours.

Lieut.-Colonel E. BALFOUR :—Under varying conditions the pace may be from 2½ to 16 miles an hour.

Major-General Sir FREDERICK MAURICE :—Perhaps I had better enlarge upon my point. I think for many years past our manœuvres have too much tended to be drill manœuvres, that is to say, however much we call them manœuvres, the one thing we try to do is to make certain attacks either on the flank, or the front, or so on. The essence of war is the use of routes of your own choosing, and amongst the combinations which are very valuable for a cycle is a possibility of your coming down wind instead of going up wind. It is one of the elements that has to be taken into account as a special feature of cyclists as an arm. It does not necessarily follow it is a disadvantage to go at different paces.

Lieut.-Colonel E. BALFOUR :—I live in a hilly country in Scotland, and the valleys all run east and west, the roads are either on ridges or along the valleys, and we have splendid cycling by going with the wind along the bottom of the valley when the wind is on our front on the top of the crests.

Major-General Sir FREDERICK MAURICE :—That is what I mean. Those are points of the greatest possible importance. They do not diminish the value of the cycle, but they do very greatly increase the importance of working out these things in practice.

Colonel LONSDALE HALE :—May I say, as I was present on that occasion, what actually happened? Major Saville determined to attack our left flank. I was with Major Berry and he concentrated well away to the north. He started with two columns on the Saturday, the right column was coming down to attack our left flank, and Major Berry thought if it got through it would sweep our left flank away. The other column was to come and make a demonstration rather to the south-east. The second column could not get along at all; they were the people who could only do the 5 miles in 2 hours, and Major Saville had to give up the attack. His men had done about 40 miles a day before, and he found it was no good trying to do anything more. It struck me that you might arrange all the plans of operations when you go to bed at night; but if the wind changes in the night and you are working with a cycle force, you will have to be rung up and alter all your plans to suit the change of winds. It is undoubtedly one of your weak points. General Dixon, who is here, may remember a day in the cavalry manœuvres on Berkshire Downs, when cyclists went up to the high ground at Wantage and could not get along a yard owing to the tremendous winds that blew across the dykes.

Major-General Sir FREDERICK MAURICE :—That was familiar to me, as I had followed the manœuvres. I quite recognise that those were the facts, but the deduction I draw from them is that when you are dealing with a new arm, you must take those conditions of the new arm into account in the manœuvring. In the days of sailing ships you would not have said that sailing ships were useless for battle, because their pace varied with the wind. You adapted your tactics to take advantage of the wind. Most of the manœuvring in the old naval engagements depended on your use of the wind. So I maintain, as regards the cycle, you must take the wind into account, and you cannot merely move as if you were moving soldiers on horseback or on foot straight to the front or to the flank, but you have to take that element into account in the working of the cycle. That was one of the things I meant by my illustration of "Little Pedlington" and the bed of Procrustes. With regard to the drill, I do not know

whether I have so far failed to convey my meaning as to give the impression that I in the least suggest that drill is not required for such purposes as mounting cycles or moving cycles along the road. I insist on that always, and I do not think you can have too much. The compactness of a body moving along a road depends on the perfection of the drill, and you must work that out in the most rigid manner as drill. What I asserted 30 years ago to be the feature of preparation for modern war, I assert now, that practice must take the place of drill, that you cannot lay down rigidly and precisely what you are going to do nowadays on broken ground, and therefore you want to be perpetually practising what you cannot lay down in the book. That, however, of course applies to the work when the men have dismounted from their cycles. What we want to do, is to be perpetually practising, because what ought to be done cannot be put in a simple way in a book. I do not intend in this lecture to go into details: there are such an enormous number that require consideration—equipment and organisation, and all these things—and therefore, I purposely referred to this paper of Mr. Newington's in which all those questions are dealt with. Turning to what Colonel Hale said, I feel exceedingly flattered that he should have preserved for so many years the memory of any speech that I may have made. As however, he recalls it, I may mention that my retort was not to any attack he had made upon me. I was striking out in defence of Brigadier-General Macdonald, against whom he had thrown me. I only objected to being used as a projectile against a speaker with whom I agreed. He speaks of being able to transfer ten battalions of 1,000 men. I quite recognise the importance of that, but it is not a new thing, because as nobody knows better than Colonel Hale, Napoleon won all his battles in the 1814 campaign by transferring on carts the whole of his Brigade of Guards from side to side between the two rivers. He habitually struck by shifting everyone of his Guards in carts: occasionally by riding and tying. It was by that means that he carried out his rapid movements. Therefore the rapid transfer of infantry is no new thing. But I do think that the habitual use of that powerful strategic weapon has been made much easier by the development of cycles. We have to take into account the fact that whereas through all the ages man has had to depend on himself or on the horse as the only means of movement, now machinery has reached such perfection that man is able to work the machine by itself, and we have to bring it into the practice of war.

The CHAIRMAN (The Duke of Norfolk):—I am asked if I wish to say a few words, but I do not wish to say anything, except to express our thanks to the lecturer and those speakers who have contributed to the excellent debate we have listened to.

FROM JAPAN TO EUROPE BY THE TRANS-SIBERIAN ROUTE.

By H. A. BONAR, Esq., H.B.M. Consul at Yokohama.

Monday, 18th February, 1901.
Admiral the Rt. Hon. Sir J. C. D. HAY, Bart., K.C.B., D.C.L., etc., in the Chair.

IN availing myself of the privilege of reading before this learned Institution a narrative of my trip home from Japan last summer, I do not claim the performance of a difficult or a novel journey. I shall feel gratified, however, if by this means so much of the ignorance on the overland travel to the Far East under present conditions can be dispelled. I think I may say that this ignorance is as great in the East as it is in Europe. But for the assurance made to me more than a year ago by a member of this Institution, then in China, who has a special knowledge of the Siberian region, that the journey by rail and river would be practicable after the spring of 1900, I should probably have given up my plan for want of information. A reference to "Murray's Guide" I thought would help me, but having obtained the most recent edition from London, I found in it but vague information as to the contemplated Siberian Railway dating 1893. Beyond question, one can now travel by river and rail almost uninterruptedly from the Far East to Europe, or *vice versâ*, in comparative comfort and at little expense. Later there will also be a considerable saving in time, and sixteen or seventeen days will suffice to get to points of that most interesting of regions which it now requires a journey of forty days to reach. I further accomplished the particular object I had in view of performing the shortest journey between Tokio and Europe with the minimum amount of sea-travelling. This may not appeal to many, but it will be a comfort to some to know that now they can reach beautiful Japan with very little risk of sea-sickness, and China by rail all the way, so soon as the Manchurian part of the railway is completed. This probably will happen at an early date, when the Russians will be able to reach Port Arthur in absolute comfort and independently of the great waterway to the Far East.

There can be no harm in Russia acquiring territory for this purpose, so long as other nationalities are admitted without too many restrictions. Manchuria will certainly be more accessible than under Chinese rule. It is not my object to speak about the Manchurian Railway, which probably will be so soon finished, but I wish to say something on the subject of that complete land communication which Russia has now had for nearly a year, and of which she was able to avail herself on the first great occasion, within two months after its completion when the troubles in China broke out. Therefore, I will not further dilate on the immense advantages, political and commercial, which Russia gains by her land communications with the Far East, for Mr. Colquhoun has already done so in a paper read before this Institution in June last.

The following statement is probably no exaggeration:—"During the three months ending 1st October (old style) the Siberian Railway conveyed 54,410 men and 11,407 horses to the Trans-Baikal territory; 46,209 men and 9,149 horses, and 3,906 tons of war material were conveyed along the Shilka and Amoor Rivers." It appears further that only 19,000 men were conveyed by sea to Vladivostok and Port Arthur during the same period. We passed the first two or three military trains going east just before reaching Lake Baikal, and they were carrying some 900 to 1,000 men each. At that rate there is nothing astonishing at the figures given above. One must remember, of course, that they were only conveyed from Irkutsk, across Lake Baikal, to Stretensk, and that from this point they were taken down the river in barges. I cannot speak as to the supply of these; there are probably enough stern-wheelers and other steamers, together with barges and rafts, available for the carriage of troops on the river. From every point of view, the Amur communication will always be a second but invaluable string to Russia's bow in Siberia.

I return now to the object of my paper, which is to describe travel through Siberia under present conditions, and which will certainly improve, regardless of the completion of the Manchurian Railway. Going East will always be an easier matter than coming West by the Amur; several days are saved on the down-river journey, and river steamers are more likely to connect promptly. My notes apply only to travel between April and September. I am given to understand that after the first week of the latter month the river begins to freeze. During the other months nothing need be feared from the climate, but one should always have a supply of warm clothes; though mosquitoes do not worry one, flies are a great annoyance, and a piece of mosquito-netting is useful. This journey costs much less than either that by the American-Continental and Pacific, or the Suez—Hong-Kong route. The railway and steamer fares are astonishingly low, first-class from Tokio to Moscow they amounted

to only £21 10s. 6d. for a distance of over 7,000 miles; if, in addition, meals and hotel expenses, at the rate of ten shillings a day for thirty days, are added, and £3 or £4 for baggage expenses, the cost of the journey need not exceed £40. That is about half the cost *viâ* Canada or Suez. Later, no doubt, as Mr. Colquhoun points out, one will be able to travel to Pekin or Shanghai for £32 10s., and to Japan for £2 or £3 more. As a matter of fact, it cost my companion and myself rather over £60 apiece to travel from Tokio to London, but that covered hotel expenses at various places where we were detained, wines and spirits and mineral waters, and the use of a servant for part of the time. It is quite certain that steamship companies will never be able to compete with these rates; further, there is no doubt that the Russian authorities will make travelling in Siberia or Manchuria as luxurious as it is in European Russia. The following statement is an example of what is intended, if not already done: "The trains now running on the Moscow to Irkutsk section on the Trans-Siberian Railway are to be heated and lighted by electricity. There are electric cigar-lighters in each compartment, and the water and milk in the dining-car are kept from freezing by electric heaters. The lamps on the sleeping berths are turned on or off automatically by drawing the curtains, etc."

With only a bare outline of the trip, supplemented by third-hand information received at the last moment from Vladivostok, my companion and I—travelling alone seemed inadvisable—left Tokio on 1st June by rail for Niigata, a treaty port on the coast of Japan, situated almost opposite to Vladivostok, and presenting one of the shortest sea routes between Japan and the Siberian coast. A Japanese mail steamer was scheduled to leave Niigata on the 4th for Vladivostok, on its monthly run from Saghalien, *viâ* Hakodate, a mail service which is carried on only from May to November. Railway travelling in Japan is sufficiently well known to require no further description. The distance from Tokio to the Western Port, some 250 miles, necessitates 18 hours' travelling, with a break for the night at the small sea port of Naoyetsu on the Japan Sea. The route is not uninteresting; the railway rises from the Tokio plain to the Karuizawa plateau 4,000 feet above the level of the sea by a series of tunnels, skirts the base of Mount Asama, said to be the largest active volcano in Japan, and then descends to the western seaboard through extremely pretty scenery. Naoyetsu is one of the many places in Japan where it is not a joy to pass a night in an inn—generally spoken of as a tea-house, which is a very different thing. A scramble for the hot bath, which one likes to have first, of course, a long and weary wait for the evening meal, much sliding of doors and clapping of hands to call the waitresses, the incessant tapping of the small Japanese pipes against the tobacco-boxes, and the conversations of loud-voiced travellers are great

drawbacks to most Japanese inns. But there are, of course, delightful places to be found where one may enjoy the luxury of a hot bath prepared specially, where nice clean cotton dressing-gowns are provided for the guests, where the mats are clean, the waitresses polite and neat, and where one can enjoy excellent Japanese food and good saké at moderate prices. The globe-trotter rarely visits places of this sort, and if he does his guide does not allow him to enjoy these luxuries, but gets them himself instead; the globe-trotter is given perhaps the worst room because he wants to keep his boots on, and has to be satisfied with a tough beefsteak which his guide has ordered for him, and is charged more than he would have to pay in most parts of Europe for much more comfort.

Unkind as it may seem to say it, the globe-trotter is not loved by the resident in Japan; somehow or other with his guide he has spoilt manners and prices. I will not say that it is always the fault of the traveller himself, his guide probably represents him as a person to be fleeced and to be put off with a minimum of comfort and the worst of everything that an inn can provide. However, there are still some parts of Japan, the unbeaten tracks, where one meets with courteous treatment and real Japanese comforts.

Niigata is one of those old-fashioned places. It is some 85 miles west of Naoyetsu, and the railway company that owns the line is distinguished for using liquid fuel produced in the district, and for numerous accidents. We spent two days there and enjoyed ourselves thoroughly. It is now a flourishing town of 50,000 inhabitants. Though it has been opened some forty years to foreign trade, it has been absolutely neglected by the foreign merchant. Until recently it was impossible to reach it except by a three days' journey over high passes, and the anchorage being an open roadstead, ships avoided the place. It is the chief town of one of the richest districts, and now has rail communication with the rest of Japan; harbour works are in course of construction, and it will probably prosper like other places opened to foreign trade. It is near to the centre of the oil-producing industry, which needs foreign capital and management to help the Echigo district to supply kerosene oil, of which Japan consumes an enormous quantity. But the Japanese have so far given no inducement for the introduction of foreign capital, and though they feel the need of it they have not cared to legislate in any way which will benefit the country if it is to benefit the foreigner also.

The out-of-the-way corners of Japan are always the most attractive, and we were sorry to leave this hospitable and cheery place for the Siberian coast. We went on board the Japanese mail-steamer "Gaisen Marn," 1,700 tons, which does the Japan-Vladivostok mail service in the summer months, and on which we found excellent accommodation, good food, and a most obliging captain and staff.

At Niigata steamers have to lie about a mile off shore, and as it is often impossible to get on board we counted ourselves fortunate in having perfect weather. Probably Niigata will never become a port of embarkation for the Siberian Railway, though it is on a straight line from Tokio to Moscow, but it will always save time to travel this way. There is also regular steam communication between Nagasaki and Vladivostok *viâ* the Corean ports. This involves some 600 to 800 miles sea-travelling, but the steamers are large and comfortable. There can be but little doubt that the passengers and goods traffic to and from Japan *viâ* Siberia will be diverted to Talienwan as the terminus of the Manchurian Railway. I was assured some years ago by one of our naval officers who has had considerable experience on the China station that the great Asiatic Railway then commenced by Russia must have its terminus at Talienwan to be of any use to the commercial communities of the East. Approximately it is situated only forty-eight hours from Pekin, Shanghai, and the railway system of Japan, and is also at the outlet for the natural trade route from the Amur through Manchuria to the sea. Originally Russia could count only on Vladivostok as the terminus of the railway which was to follow the Amur to Khabárovsk, but Talienwan is an ice-free port, Vladivostok is not. It is the only port free of ice to which the railway could be brought.

We crossed the Japan Sea in the finest of weather in 46 hours travelling at 9 knots and we reached the entrance to Vladivostok on the morning of the 6th. We were indeed fortunate to find a thick fog lifting. In the summer months, owing to fog, the approach is so difficult that none but the boldest navigators would dare pick their way to the harbour. The entrance to the port is very picturesque, but the scenery is a secondary consideration, and attention is attracted to the new forts going up in every direction. The harbour of Vladivostok, one of the best in the world, is completely hidden from view when approached from the sea. The steamer took a sharp turn to the right and the inner harbour and the town of Vladivostok came suddenly in view. I had notions of a dreary and miserable-looking fortress such as it probably was not long ago, so I was astonished to find a gay-looking town with rows of magnificent buildings built up on ground rising sharp from the water's edge. A boom in land and buildings has recently set in, but all the palatial buildings are not as yet occupied. Since the acquisition of Port Arthur the Russians are determined that Vladivostok shall be a commercial as well as a naval port. Of shipping there was not much in the harbour, but it was interesting to see the cargo which was being discharged by some three or four British steamers. It consisted of railway material, and some twenty or thirty engines were lying about on the wharf; by now they are probably in the centre of Manchuria. Other shipping was fairly well

represented. The harbour is truly an ideal one; the innermost arm capable of holding more men-of-war than are ever likely to congregate there is reserved for naval purposes and extends for a mile or so and is absolutely sheltered. There was only one Russian man-of-war at anchor, and there was also an ice-breaker, which is to give access to shipping in winter.

Vladivostok is inhabited by some 29,000 Europeans, Chinese, Coreans, and Japanese. It is governed by a military Governor, a smart and distinguished officer. There are various reports as to the strength of the garrison. At a moderate estimate it consists of some 12,000 men, whose number can at short notice be increased to probably 30,000 by drawing on neighbouring military posts. I was told on excellent authority that within five days of the order for mobilisation being issued in June last 11,000 men were on their way from Vladivostok to Port Arthur.

The trade of Vladivostok is almost entirely in the hands of foreigners, principally Germans. One German firm, with a turnover, it is said, of some 7,000,000 to 8,000,000 roubles—say, £800,000 to £900,000 per annum—appears to have almost the monopoly. In a vast establishment, with banking and shipping, import and export departments, they employ over a hundred European clerks; there is also a large store similar to one of the large London co-operative stores, where every article for household use, wines, spirits, and provisions can be bought at fairly moderate prices. There are, besides, a number of other shops where the traveller can buy everything he is likely to want for the Siberian journey. We had brought a quantity of stores and bedding, which is most indispensable, but most things can be bought as one proceeds. There is only one British firm in Vladivostok, and I did not hear of another in Siberia. The Germans are well established there.

On landing from the steamer we were surprised to find no customs officers. Likewise, when we ultimately landed with our baggage, there was no one to inspect it, and for the present the imposition of customs duties seems to be in abeyance. There were crowds of Chinamen and Coreans on the landing stage, squabbling for employment. A Russian gendarme kept them in order by boxing their ears. There were, besides, most repulsive-looking emigrants camping in the open air with their baggage; altogether it seemed as if the ruffianism of the East had collected on the spot. The droschke drivers were certainly villainous-looking specimens of escaped and released convicts from the neighbouring Russian penal settlements. It would be wise not to venture away from the main thoroughfare of the town at night. The shabby-looking droschkes were patronised almost entirely by smart-looking military and naval officers, being driven in every direction at a gallop, regardless of ruts and holes. The streets are in a shocking condition, and in rainy

weather are almost impassable. Droschke fares are only 40 kopeks (10d.) for a short distance, and had better be used for going about the town or when taking baggage to the station. Though the latter is only about 100 yards from the landing stage, one has to drive nearly half-a-mile to gain admittance into the station with one's luggage. There are several hotels in Vladivostok; the "Hôtel du Pacifique" and the "Zolotoi Rok" (Golden Horn), which has a theatre attached to it, and where the high life of Vladivostok congregates in the evening. Fortunately we found both hotels full—I say fortunately, because we were in no hurry to make acquaintance with what no hotel in Siberia is reported to be without, and that is vermin. I have heard previous travellers declare that one particular variety was not infrequently served up in the soup. We arranged, therefore, to stay on board the Japanese steamer, and found it very comfortable, as we were only 300 yards from the shore. We had to spend two days in Vladivostok, and they were tedious enough; the neighbourhood is absolutely uninteresting except, perhaps, to those in search of knowledge, which they are not likely to get.

We heard anything but encouraging information as to our further progress through Siberia. No one seemed able to give accurate details. We were told that crowds of passengers were waiting at Khabárovsk for more water in the river, and that we were not likely to get a passage; further, that the new railway section on this side of Lake Baikal was in a dangerous condition, that passengers had to travel in cattle vans and had to sit up, forty crowded in a carriage, for three days and nights. All this was not encouraging. However, Messrs. Kunst and Albers, to whom we brought a letter of introduction, secured us passages on the up-river steamer leaving on 11th June. Steamers leave Khabárovsk every fifth day for Blagovestchensk, so that one is bound to be delayed at Vladivostok. Travellers are warned not to push on to Khabárovsk, the accommodation there being of the worst. We heard of other English passengers having preceded us, and at Vladivostok we met two others from China also bound west. There is only one train each day between Vladivostok and Khabárovsk, a distance of 406 miles, time 27 hours. The train is timed to leave at 9.45 in the morning, but we were wise in getting there before 9 o'clock. To get one's luggage through requires much patience and determination, moreover we were at a great disadvantage, being overloaded with luggage—mostly stores and bedding—and not being able to make ourselves understood, as we knew no Russian. French and German did not seem to help much, though the latter proved the more useful language of the two; but it was a most agreeable feature throughout our journey to find the Russians most exceedingly courteous and helpful in extricating us from difficulties caused by a want of know-

ledge of the language. On the railway only one pood (36 lbs. English) is allowed free, and excess is charged at a very high rate; but we piled all we could into the carriage, and considered ourselves lucky in getting off for 15s. for excess luggage to Khabárovsk. The passenger fare was moderate enough—34s. for 400 odd miles. The carriages are very comfortable, on the principle of the *wagon-lit*; there are seats for four only in each compartment, and at night four comfortable berths can be arranged. Our first business was to make friends with the conductor, this we did by presenting him with some Japanese paper napkins; he was delighted, and we were left alone the rest of the journey. One must always be ready to use inducements of some kind, and, as a rule, money will secure everything. The lavatory arrangements on the train, and, as a matter of fact, on the Siberian steamers and in the hotels, left very much to be desired. But the Russian traveller does not bother very much about washing, and with a little management one can get on well enough. Besides our bedding we had brought enamelled washing basins and a canvas bath—all proved most useful. There is a restaurant car of somewhat uninviting appearance attached to the train, and meals of all sorts can be had at prices of about 1 to 2 roubles (2s. to 4s.). As is well known, the Zakuska, or preprandial refreshment, consisting of vodka and caviar, ham and various cold dishes, is much relied on as a preparation for a Russian meal, and we made it take the place of a meal sometimes. We found our provisions came in most useful, and really had little need to go to the restaurant car. Tea (Russian fashion) is to be had always; and as boiling water is easily got, cocoa will be found a valuable addition to one's stores.

The scenery after leaving Vladivostok is of the Canadian type—extensive woods and a scarcity of villages. There are many stations, mostly for the purpose of watering the train, and taking in fuel in the shape of rough logs. The speed of the train is about 15 miles an hour, and only one important station is passed, that of Nikolsk, from where a line branches off to meet the Manchurian line at Kharbin (pronounced Harbin). This section and several others are already in working order. The construction of the Vladivostok-Khabárovsk section would appear to have been premature. But it is not so, as it establishes most important communications with the Amur. The fact of its being entirely on Russian territory is, perhaps, of no consideration from a Russian point of view. The accompanying map, which I have reason to believe correct, will explain the actual and future communications of the Amur and the Manchurian region. Whatever happens to the Manchurian Railway—and I do not think much will happen to it now—the Amur River communication will always be available, in summer at events. We arrived at Khabárovsk shortly after midday on the day following, having

spent quite a comfortable night in the train. The town is about a mile from the station, and the baggage is conveyed on rough carts driven by Coreans. We had no idea where we were to lodge at, though we heard there were two hotels, called, strangely enough, "The London House" and "The Rossia Hotel." We selected the latter, and we were wrong. There were actually no rooms available, but we persuaded the landlord, who was originally of German nationality, to let us have two rooms which had been reserved. These rooms were spaces 5 feet by 9 feet, with a small bedstead and a tumble-down washhand-stand. We felt sure that we should here experience the plague of Siberian hotels already alluded to. We had to give up one of the rooms to our fellow travellers, but hearing that the up-river steamer would arrive in the course of the afternoon, we went down to arrange to spend the night, if possible, on board. We succeeded in doing this, and returned to the hotel for dinner, which proved a villainous meal. Our bill for that and the temporary occupation of our room came to 19s. We thought that a bad beginning for economy in travel; but these high charges proved exceptional, and prices for rooms are much the same as in Russia. Travellers are warned not to stay a night in Khabárovsk if they can avoid it.

Khabárovsk is the principal seat of government of the Primorsk Province which extends some 2,000,000 square miles, and is the residence of the Governor-General, who is also Commander-in-Chief in Eastern Siberia. He has under him three governors of districts residing at Vladivostok, Blagovestchensk, and Chita. The town, which is inhabited by some thirteen thousand souls, is built on heights overlooking the Amur at a point where the Ussuri River joins it and commands a most extensive view of the Amur River which is here some 1½ miles, but very shallow.

We were fortunate in securing a three-berthed cabin on the up-river steamer and were agreeably surprised to find the steamer clean and commodious and the lavatory arrangements better than expected. The "John Cockril," as she was called, is one of half-a-dozen passenger steamers originally built in Europe and then added to and built up for passenger accommodation. The upper works are so high that the funnels almost disappear. The steamers carry the Imperial mails and are as regular as the state of the river will permit, but ample allowance is made for the journey up river. The official time tables give five days for the length of the passage to Blagovestchensk a distance of 918½ versts (612 English miles) (a verst is two-thirds of a mile).

The navigation of the Amur by steamers commenced as early as 1844. The present steamboat service is carried on by the Amur Trading and Steamship Company and by the Amur Navigation Company. The former company is in receipt of a Government subsidy, but owing to mismanage-

ment, so it is reported, is financially in a bad way. The other company had better not be relied on, and though its steamers may hold out a prospect of arriving two or three days earlier than the following mail steamer, passengers stand a very good chance of being stuck in the river. We were none too early in having taken possession of a cabin—there was indeed a crowd of passengers waiting to go up river, and the price paid for an extra berth was well worth the extra comfort. Most of the first-class cabins have two berths. Here as everywhere else one's own bedding comes in most useful. Passengers travelling east or west are recommended to secure their accommodation in advance. Though military officers of high rank naturally get the preference, applications for accommodation are fairly treated in order. Before leaving Tokio I was very kindly furnished with letters of introduction from the Russian Minister to the Governor-General of the Amur Province, and anticipating difficulties on the new railway section, I determined to seek his assistance to secure as much comfort as possible. I was most courteously received by His Excellency General Grodékoff, the present Governor-General, who promised at once to secure for my friend and myself accommodation in one of the official carriages. I shall mention further that he did me the honour to invite me to breakfast, an occasion which afforded me the opportunity of witnessing some of the enthusiasm which animates the high officials of Siberia. I found myself one of sixty guests nearly all military officers of the highest rank, including the three Governors of Provinces who had been assembled to celebrate the unveiling of a statue to the memory of those who had lost their lives in the work of acquiring for the Tsar of All the Russias these distant and desolate regions. The toasts which were proposed by the Governor-General and which I could only guess at, were no doubt loyal in the extreme, and expressive of further efforts to be made to accomplish the great work begun in the Far East. They were solemnly but enthusiastically received and cheered to the accompaniment of military music. The whole administration of the Governor-General was represented at this banquet, and those officers with whom I was able to converse were most affable and seemed gratified at the attempt we were making to travel to Europe by the new route. They had no doubt as to the great facilities that were offered by it, but asked one to be indulgent on the score of discomforts which would soon be made to disappear. I promised I would give the new route a fair trial, and judging from my experiences I am quite prepared to undertake the journey again. On taking leave of General Grodékoff, he recommended me to the care of two generals, travelling westward, one of whom was relinquishing command of his military district and returning to Europe with his wife and son. Most amiable and charming travelling companions they proved. The other, a

general of cavalry, was going (as he thought) on short leave to Paris. He was recalled on the way and within a month of his departure was back again fighting the Chinese. Reluctant as one may be to rely continually on the assistance of others, it is a wise plan when travelling in these parts to be furnished with letters of introduction. Of course if one's object is the acquisition of special knowledge it is better not to use letters of introduction. Needless to add that under any circumstances a passport is absolutely indispensable.

To resume our journey, we left punctually at four in the afternoon, and were pleased to find that not all who crowded the steamer were coming on. As it was, there seemed hardly any room to move, and all the children for hundreds of miles around seemed to have collected on board. There was a most varied crowd of passengers, every rank of military and civil officialdom, engineers, doctors, schoolmasters, actors, all travelling westward, and of whom quite a number were bound for Paris. My friend's deck-chair soon became public property, and for peace and comfort we retired to our cabin. The after part of the steamer is given up to second-class passengers; as to third-class travellers, they disappeared somewhere during the day, but turned up to sleep on deck. There was no room to walk round the deck after 9 p.m., and one would come across whole families who had come to sleep there. Our principal trouble was with the meals. The supper, 8 p.m. (dinner always at midday), consisted of one dish only, generally some hard meat covered with a thick brown sauce. But we found, however, we need not pay the regulation two roubles a day (4s.), which included tea and bread and butter in the morning, midday dinner and supper, and that we could order what we liked and pay for each item. We managed our meals somehow; either we cooked them ourselves in the cabin, or got the steward to have our provisions cooked for us. Entirely unassisted, that poor steward, he had to wait on about twenty first-class passengers; we had pressed a rouble in his hand on arriving on board, and he looked after us well. We gave him more on leaving, and he got part of my wardrobe, which I intentionally meant to diminish as I went along. For one person two roubles is a good fee for the steward; but how that man managed to do all he was required is still a mystery. However, we did ourselves very well, and only smiled when the thick, brown, cabbage soup with huge lumps of black meat floating in it, eagerly fished for by everyone in turn, was put on the table. Our immediate friends we treated with biscuits and jam after every meal, and much they appreciated it.

When the steamer stopped there was always a crowd of women and children on the bank with fresh baked loaves, milk, eggs, and generally fresh caviar by the plateful. Once you have eaten the newly-prepared caviar, you do not want to eat that which is sold in shops. It looked like

a dish of the smallest and freshest green peas, and tasted rather better. It is eaten by the spoonful, and a plate costs a few kopeks. So if a traveller is particular about his food on board, he can always buy fresh bread, milk, and eggs at the various villages where the steamer stops. Certainly the bread looks most appetising, and is, as a rule, good. The stoppages occur every seven or eight hours; but there are some forty places marked in the itinerary. The stoppage is more for the purpose of taking in wood than to land or take in passengers. Opportunities are thus afforded of taking a short walk on shore. The villages are all inhabited by Cossacks and their families. Their habitations are of the roughest description, but are stoutly built of timber. There is an imposing looking church in every village, and right through from Vladivostok to the Russian frontier a Russian church is an ever-present feature in the landscape. Until recently some 12,000 Cossacks only have had the guarding of the Amur banks; by now their numbers have, no doubt, been largely increased. The Chinese bank of the river is said to be infested with brigands, and skirmishes between them and the Cossacks are frequent. I cannot help thinking that much of the fighting in Northern Manchuria was of this kind. At one village a display of horsemanship of the Cossacks was arranged for one of the generals. The feats they performed were certainly wonderful. Though for miles everything is desolation, I cannot say that I saw signs of misery or distress; resignation, if not contentment, was expressed on the women's faces.

For the first two days after leaving Khabárovsk the banks of the Amur are flat and sandy, covered with coarse grass and jungle; no habitations were to be seen on either bank for miles. But the monotony of the passage is pleasantly relieved during some twenty-four hours where the Shighan Hills close in on the river, causing the stream to be deep and presenting extremely pretty scenery. After that the banks once more become flat, and the only object of interest before reaching Blagovestchensk is the Chinese town of Aigun, situated some 26 miles east of it. As we passed it, this Chinese town, with its mud encampment, presented a most peaceful aspect—there was not a sign of a soldier about, and one could never have supposed that a fortnight later this district would prove the scene of a determined attack by the Chinese on Blagovestchensk. What interested us passengers most were two live sturgeons that had been caught on the opposite bank, and were still struggling.

We made very good time and reached Blagovestchensk ninety-six hours after leaving Khabárovsk, the steamer keeping up an average speed of 7 miles an hour. The draught of water was only 4 feet, and even then careful navigation was necessary to take the craft through the narrow channels left for navigation. Blagovestchensk, with its tall

buildings and churches could be seen miles across the sands formed by the River Zeia, which joins the Amur just below the town. The Zeia is navigable for a certain distance and leads to regions where gold is abundant. The difficulties of mining it are enormous, due particularly to want of protection from brigandage.

With our arrival at Blagovestchensk, the most comfortable part of the river journey ended, and we heard all sorts of stories as to difficulties and trials awaiting us further up. We could get no reliable information at all. It was reported there was no water in the river, and that to get up at all we should have to travel in barges. One thing was clear, and that was a detention of three days at Blagovestchensk before we proceeded; there were outside steamers of miserable description ready to leave at once. Some of the more venturesome passengers went on board and started, but were back again within 36 hours. We landed with all our baggage, and piloted by one of our general friends found our way to the Grand Hotel and secured an excellent room—a room which would be good in any European first-class hotel. We were astonished to find such accommodation in the very centre of Siberia, and the two of us paid only 4 roubles (rather over 8s.) per day for the room. Travellers in Russia know probably that though the price of a room seems high, there is no limit to the number of beds that can be put into it, and it is much cheaper to occupy the same room; an extra bed only costs 50 kopeks (or 1s.). We found in the manager, a Frenchman by birth, a most obliging individual, and were delighted to find excellent cooking and good wines and beer. It is difficult to realise that this, the principal town of the Amur Province, and now containing 32,000 inhabitants, was a few years ago only a military outpost. There are splendid shops, and the large stores of Kunst and Albers provide everything. The town is also the residence of a Governor, and its military and commercial importance are undoubted. The traveller is advised to replenish his stores here, for it is on the next stretch of river that he will most require them. It is advisable also to take a supply of mineral waters, although they insist on charging corkage on board the steamer. Most passengers drink the Amur River water, but it is not safe to do so.

I mention one little irritating incident which occurred within a few minutes of my entering the hotel, as a warning to observe certain Russian customs. One is, to take off one's hat when entering a room. Every room has an ikon (saint's picture); but walking through the hall of the hotel, which was also used as a dining-room, I omitted to uncover my head, and my attention was immediately drawn to my apparent rudeness by some Russians sitting at a table. Of course I at once did what I ought to have done before. The Russians are very touchy also in the matter

of the daily greeting, and one should not omit to shake hands on every available opportunity. It is best not to be particular as to whom one shakes hands with, but one should certainly greet one's train and steamer acquaintances in that way; by all means shake hands with the conductor of the train every morning.

We spent the time in Blagovestchensk pleasantly and comfortably, although there is nothing to see, but the weather was fine and surroundings cheerful. On the morning of the 18th we went to secure our accommodation on the small steamer, which we heard might possibly take us as far as Stretensk, as the water in the river had increased. We found she was only drawing 3 feet, and was quite a small craft compared to our first steamer. The accommodation was not nearly so good and it certainly looked as if we were going to have an uncomfortable time of it. Some of the passengers were put on a barge, which was towed up by our steamer. The cabin accommodation was fair, but the washing and sanitary arrangements could hardly be worse. The first-class saloon was crowded, and as usual one steward had to do everything. We managed to secure the services of a Russian who had been a servant and who was working his way home. We paid him a small sum per day and he did everything for us. He spoke a few words of French, which unfortunately for him he could never use correctly. Every enquiry he replied to "*Je sais; je sais*," and was going to do everything *tout de suite*—he never knew anything, and we found that like in Japan there was no such thing as "at once" in Siberia, but he was useful all the same. It would make all the difference in comfort and not add so very much to the expense to take a servant on this journey. The minimum estimate of our passage to Stretensk was now ten days, although seven days is the time calculated in the time-tables. We heard of previous travellers who were sixteen days on the way; we were lucky in getting off with eleven.

We left Blagovestchensk at 8 p.m. on the 18th, seven days from Khabárovsk, regretfully leaving hotel comforts behind us. For two days the scenery, although more varied, was not particularly interesting. But two days' steaming brought us to a part of the river where the banks were of a peculiar formation. They appeared to be on fire in a dozen different places, some close on the water's edge, and yet there seemed nothing but sand and stone to burn. It couldn't be sulphur, but it was probably coal burning by spontaneous combustion. The scenery became more and more interesting, and having once more settled down to the routine of our steamer life, we thought that things might have been very much worse. So far I have said nothing on the navigation of the steamers. Up to Blagovestchensk it seemed simple enough; pilots steer the steamer by landmarks in the shape of tall posts every few hundred yards, which at night are lighted up with a red lantern. On this stretch, however, it is

not safe to navigate throughout the night, and we anchored generally about eleven, and proceeded at daybreak the next morning. The navigation on the Stretensk stretch is very intricate, and I wonder the steamer did not go ashore a dozen times. Though the pilot steers the steamer, the captain is supposed to look out in dangerous places. I regret to say that our particular skipper spent nearly the whole of the twenty-four hours gambling with passengers in his own room. However, a sharp look-out is kept by two men forward, who with weighted poles, take continuous soundings and shout the same. When one hears only 4 feet or 3½ feet called, it becomes exciting. Once we did grate over the stones in the bottom of the river and thought the steamer must have got damaged, but we were not told. We only stuck once, but fortunately got off in about two hours; it was lucky we were not there two days. One wonders how it is possible to keep the river lighted on a stretch of river over 2,000 miles in the uninhabited parts. It is done by solitary individuals who, late in the afternoon, may be seen paddling about in a dug-out, whose duty it is to trim and light the lamps, some of which are in most inaccessible places on the face of rocks. It is impossible for these individuals to be travelling to and from the villages, and they have to live in the solitary wooden huts seen here and there. The most important station is Pakrofka, which we reached on the sixth day. It is situated a mile or so below the point where the Shilka joins with the Argun in forming the Amur. It is a long straggling village in a desolate-looking district, where a little cattle rearing and corn growing provide occupation for a scanty Siberian population largely supplemented by Chinese labourers. Here we were detained twenty-four hours because the steamer could not proceed further, and had to wait for a barge to take us up to Stretensk. The barge duly arrived in tow of a tiny little steamer with a full complement of passengers just arrived from European Russia and bound eastward. Among them was a group of some dozen ladies, and their cheerful appearance removed much of the doubt we had as to the difficulties of the railway journey.

The barges on the Amur used for the conveyance of passengers are in one respect more comfortable than the steamers, the heat of the engines is avoided. Drawing only 12 inches of water, and about 120 feet long, they have two decks. The lower deck is divided into two large cabins, for male and female passengers; there is no division between the bunks, but it is easy enough to curtain them off with rugs, etc. On the whole, the accommodation was much better than we expected. On the upper deck there is a small dining saloon, above that again there is a deck without any protection, which the Moujiks (peasants) used to lie about on. The cooking left much to be desired, and we had to rely almost entirely on our provisions. The boat that had brought us up left

immediately with her passengers, who would probably reach Khabárovsk in less than eight days. Finally we got under way again—it didn't seem to matter much when we arrived at Stretensk. A mile above Pakrofka we entered the Shilka River, and for four days we travelled through extremely pretty scenery. But we were severely tried by hundreds of horse-flies, which settled on the barge, and made life miserable. Moreover, the sun was very hot, and one was of necessity confined to the cabin below. Still everybody remained cheerful, and seeing how badly others fared who had not provided themselves with luxuries, we had not so much to complain of. The patience of the lady passengers, more especially that of Princess K———, the general's wife, was wonderful. The journey must indeed have been trying to them. It is doubtful whether other European ladies would bear it so well. A few years of life in Eastern Siberia had accustomed them to discomforts. Right through one was struck with the contentment of those poor unfortunate wretches who are in Siberia seeking a livelihood and who are compelled to travel from one place to another. They would sleep anywhere, and were satisfied to eat only black bread, which was so mouldy that it was broken up into small pieces and put in the sun to dry. At Pakrofka we first heard of troubles in China and of the mobilisation of Russian troops at Vladivostok, and sharp work it must have been, for on our passage to Stretensk we passed several barges with men and horses going down the river. There seemed general satisfaction at the prospect of war, but it was not known whom Russia was going to fight. Telegraphic news was scarce. We finally arrived at the end of our river journey on 29th June, having taken eighteen days to do 798 miles. Stretensk is a large village rather than a town, with a fair number of shops; but the hotel is bad. The Shilka River is fairly swift, and crossed by a ferry, the only means of reaching the railway station on the opposite bank. The train was timed to leave at 11 o'clock at night, and we had a long and weary day before us. As we had heard, there were nothing but baggage trucks fixed up with wooden seats for the conveyance of passengers over the 400 miles to the shores of Lake Baikal. It was nearly three weeks since the Governor-General had given directions about special arrangements for us, and a special carriage which we were to have was doing other duty somewhere else. From 9 o'clock till 11.30 p.m. we sat on our luggage on the platform waiting for this carriage, and really began to think we should have to do like all our fellow passengers,—pig it out in one of the vans, each one of which was crowded with all sorts and conditions of Siberian travellers, men, women, and children crowded together in hopeless confusion. For most of them sleep must have been out of the question, but judging from their appearance on the following day they seemed brutelike in their absolute disregard for comfort or clean-

liness. Most of our fellow passengers managed somehow or other to get enough room to lie down in. At the last moment our "wagon de service" was put on, and we were able to make ourselves comfortable in a first-class coupé with a lavatory attached to it. The general and his family had a large compartment to themselves, and owing to their continuous and cordial assistance we certainly got all the comfort that could be had on that journey. Similar circumstances are not likely to occur again, for ordinary first-class carriages were to be run from August last. The line was not sufficiently set to allow heavy carriages to be used. The engineering difficulties for a considerable stretch above Stretensk must have been considerable; but as we proceeded we reached level regions, and saw a fair amount of cultivation on either side of the track. There were buffet stations at irregular intervals, and for that part of the country the catering might have been much worse. Only two towns of importance are passed, Nerchinsk and Chita. The latter is the chief town of the Trans-Baikal province situated on the high road to China and to Eastern Siberia and is likely to become of great importance. As we approached Lake Baikal we met military trains coming East; this caused delays of several hours at some of the stations; but considering that this was the first military use made of the railway, things seemed to go smoothly enough. We also passed a train conveying convicts. They were carefully guarded, but seemed fairly comfortable. The former method of marching convicts for hundreds of miles through the Siberian deserts is now at an end. In every respect the Siberian Railway will be a most civilising influence.

Travelling for three days and three nights we reached Misovaia on the shore of Lake Baikal, and for a whole day awaited the coming of the ice-breaker, which in summer is used for ferrying across passengers and cars. And a wonderful craft this ice-breaker is. The whole interior space of the ship is arranged to take in a whole train, but it appears that the sea-going capacities hardly warrant a heavy train being put on board, so only the mail car and the baggage van were ferried across, and passengers walked on board with their belongings. There is a beautiful saloon, and catering and wines are excellent. The ice-breaker, originally constructed by Armstrong & Company, was brought out in sections to Lake Baikal and put together on its shores. She does not fulfil all the requirements. Crossing Lake Baikal is like going to sea, and storms are frequent and of great violence. The scenery on the shores is said to be remarkably beautiful; but we crossed in a dense fog and saw nothing. The distance to the railway station on the other side is only forty miles, and the passage lasts about four hours. At Listvinitschnoïe, only forty miles from

Irkutsk, great confusion still exists, and only baggage vans and fourth-class carriages were available for passengers.

Leaving at midnight we experienced probably the greatest discomfort of our journey, and arrived at 5 o'clock in the morning in the foggy and dusty atmosphere of Western Siberia, feeling absolutely wretched. The station is nearly two miles from the centre of the town, and in the early hours of the morning hunting for hotels was a dismal proceeding. We forced our way into one and waited for a room that was to be vacated presently; every hotel was full. For an old-established town the condition of the hotels at Irkutsk is of the worst. Later on in the day we shifted over to the hotel "Decco," which is perhaps the best. We had to put in two days, for the weekly *train de luxe* only leaves on Friday, though ordinary first and second-class express trains leave every day. The fares by these are cheaper, of course, but one takes 11 days to reach Moscow instead of 8½. There is no need to describe Irkutsk, as we have now reached districts more or less well known. Our hopes had been centred in the *train de luxe*, of which one had heard so much in newspapers. But we were unlucky enough to travel the very week when the real *train de luxe* was not running. The one timed to leave that week was on show at the Paris Exhibition and performing numerous journeys between Paris and Pekin. We found our train to consist only of one first and two second-class sleepers and a restaurant car. There was no drawing-room car, no gymnasium, or bath, etc., such as we had been led to expect; the car, however, was clean and new, and as only a moderate charge is made for sleeping-berth accommodation, one could be very comfortable with a two-berthed section to oneself. In the matter of railway fares Russia is distinctly ahead of other countries, and the charges for sleeping-car accommodation in other countries of Europe generally are extortionate compared to those charged on the Russian railways. It would be quite possible to travel second-class right through Siberia by steamer or rail; the difference in comfort is slight, but there is a considerable difference in the fares. The freight for excess luggage is, of course, a considerable item, but as it is only 14s. per 36 lbs. for a distance of nearly 4,000 miles, the charge is not very high. At Irkutsk they were very particular as to the amount of luggage to be taken into the compartment, but with a little management one of the attendants can be got to take charge of smaller luggage that one may require during the journey; in fact, one can arrange to have access to one's baggage right through the journey. The attendance is good, and the officials very civil though stern. We fared quite sumptuously in the restaurant car, and found prices quite moderate. Let me recommend two or three particular dishes which can generally be got, and which most people will approve of. One is "sterlet" — a Russian fish prepared in various ways—and is most delicious. Then

"riabchick" or (hazel grouse) is always in season. The bill of fare is fairly varied; there is a set midday dinner, price 1·25 roubles (3s.), which, as a rule, is very good. On a long railway journey the most refreshing beverage is kvas, a sort of cider prepared from various fruit; the Crimean red and white wines, generally of uniform quality, are also recommended, and good beer is to be had everywhere. The journey from Irkutsk to Moscow has also been described in guide books. One crosses some of the largest rivers of Europe and Asia. The bridges in particular are wonderful examples of engineering skill. We passed *en route* the last batch of political convicts, which included a lady. The days were monotonous, but the journey did not seem very long after all, and we reached Moscow on 14th July feeling very fit. Let me recommend a stay of two or three days at least at Moscow. It is doubtless one of the most interesting cities of the world.

I give below a table of distances, the time taken over various stretches of the journey, and of the steamer and railway fares. I have no hesitation in saying that the journey is quite feasible for ladies who are accustomed to travelling and who don't mind a long railway journey. Personally, I have found the trip sufficiently enjoyable, and am quite disposed to travel through Siberia again.

From.	Miles.	Time taken. Days.	Detentions.	Fares, Approx.
				£ s. d.
Tokio to Niigata, rail	225	1½	2½	0 17 6
Niigata-Vladivostok, sea ...	450	2	—	2 12 0*
Vladivostok-Khábarovsk ..	476	1½	2½	1 14 0†
Khabárovsk-Blagovestchensk...	612	4	—	2 6 0†
Blagovestchensk-Stretensk ...	798	11	3½	3 0 0†
Stretensk-Irkutsk	788	4½	1½	2 0 0†
Irkutsk-Moscow	3,946	8½	2½	9 0 0†
	7,295	33	12½	21 9 6

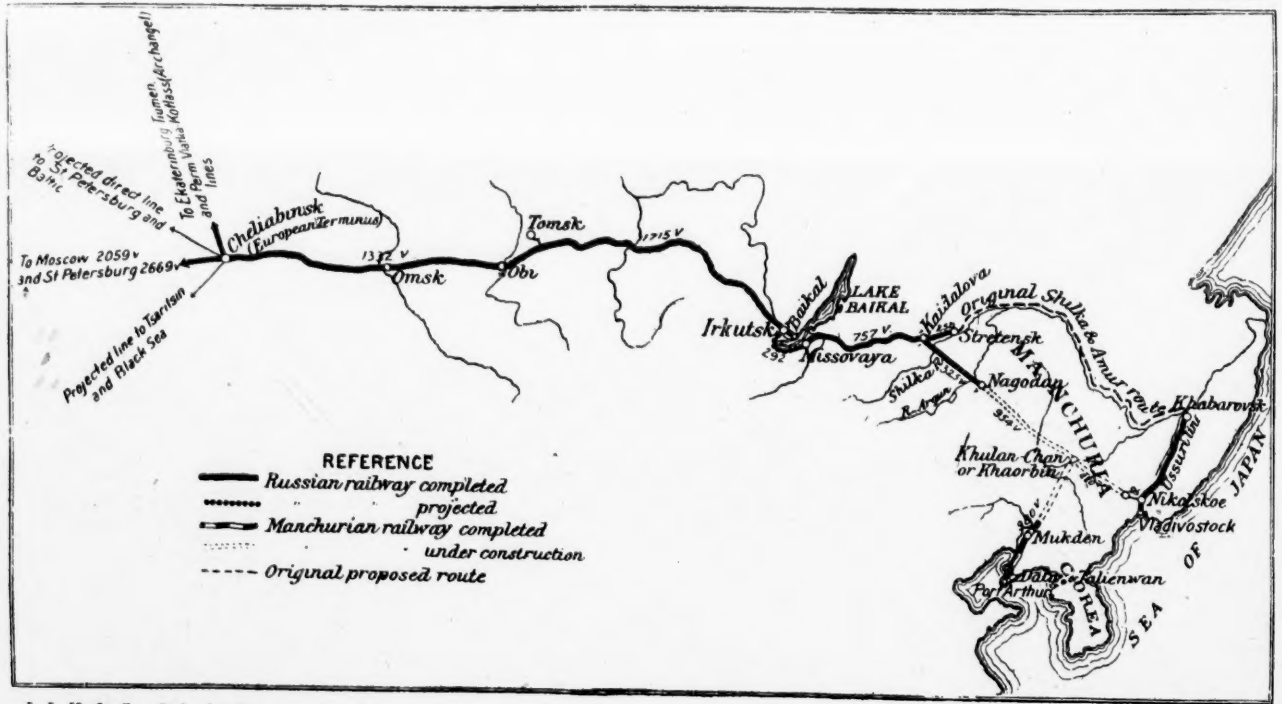
* Including food. † Excellent.

Journey, 45 days.	£ s. d.
Distance, 7,295 miles ... ... cost	21 9 6
Extra luggage	2 10 0
Hotel expenses	6 5 0
Meals, 33 days' travelling at 3 roubles (6s.)	10 0 0
Cartage and droschke	2 0 0
Tips	2 0 0
	£44 4 6
Add to that an allowance of £16 for journey from Moscow to London	16 0 0
Total	£60 4 6

Major E. J. MEDLEY (17th Bengal Cavalry) :—It is only five weeks ago since I left Irkutsk, so perhaps I may be able to supplement by a few up-to-date remarks what the lecturer has told us of his journey by steamer and train across Siberia. My experiences on the Siberian line were winter ones, and, therefore, differ in certain respects from what the lecturer experienced travelling in the summer. He came across Siberia from the East ; I came to it travelling through Asia from India in the South. I can recommend coming either from the East or from the South on to the Siberian line as preferable to coming from the West. The standard of comparison, it should be remembered, is more of an Asiatic one. It is hardly fair to compare the trains on the Siberian line, which is a new line, with the 50 or 60 miles an hour on our European trains. With regard to what the lecturer said on the subject of the small animals in the hotels, I travelled through in the winter, and although I took several bottles of Keating's with me, I am bound to confess I never had any occasion to use them. It is only fair, I think, to give that praise to the Siberian hotels, which certainly, from my experience of them, is most favourable. Of course I am comparing them with Asiatic and Indian hotels, and not with European hotels. One must remember that the Siberian line has only been completed barely six years, and it takes a little time for a railway to introduce European manners and customs into Siberia. Coming from India and Asia, of course, the hotels are Asiatic and absolutely different from European hotels. My first experience of the railway was at Tomsk. When we sank down in the luxuriously cushioned chairs and divans and the electric light was turned on, it was certainly a great revelation to me. At Irkutsk, I believe, since the lecturer was there, another new hotel, called the Métropole, which is quite up-to-date in all the latest European arrangements, has been opened. On the Trans-Baikal section, although it has not been actually taken over by the Siberian Administration, it has vastly improved since the summer. The first and second-class carriages run now are just the same as on the section between Irkutsk and Moscow. The pace is a little bit slower, but the comfort is exactly the same. They are now talking of continuing the through Moscow-Irkutsk train on to Stretensk. I went on to Stretensk from Irkutsk, and had the good fortune of crossing the Baikal on these new ice-cutting steamers. There are now two, the "Baikal," the big steamer which carries a whole train across and which is kept chiefly for goods traffic, and a small steamer, the "Ungara," which is mainly concerned with passenger traffic. It was one of the most curious experiences I have ever undergone, to see by electric light one of these steamers cutting through the ice and crossing the lake, and seeing the ice ploughed up on either side by the ice-cutter. M. Hulkoff, the Minister of Communications in Russia, had hoped to keep communication open all the winter by means of these steamers, in which case they might have postponed for some time the building section round the Baikal, which is expected to be very expensive, because it is solid rock cutting all round. Unfortunately, when I was coming back the shaft of the screw of the big "Baikal" steamer was broken. It was not considered advisable or thought possible for the "Ungara," the small steamer, although it accomplished the journey in 12 hours, to maintain this communication across the lake through the winter, and therefore immediately after my passage across—I was fortunate enough to be on the last trip—the communication was stopped for two months. When we arrived across the lake we found a train load of passengers from Irkutsk waiting to go across, and much to their horror and indignation they all had to return to Irkutsk. A certain number of them, whom business compelled to get across the lake, undertook the journey of 60 miles across on the ice on small sledges. Of course, there is no mark showing the road, and the 60 miles across the lake have to be done straight away on end with

one pair of ponies. It may be interesting to know that at Stretensk we encountered the same amount of cold that the Duke of Abruzzi met with on his journey to the North Pole—52° centigrade. That was the only really bad cold that I had the whole time; luckily for us there was no wind, still that one day gives one an idea of what Siberian cold can be. Returning from Stretensk, we travelled back with two officers, one from Pekin and one from Manchuria. The officer from Pekin had been wounded in the Pekin fighting. He had sustained severe concussion of the brain in a railway accident between Pekin and Taku, and coming up the Amur in the winter he had lost all his toes. He travelled from Japan to Vladivostok, then up the Amur exactly the same way that the lecturer did, from Khabárovsk to Blagovestchensk. There was not enough snow, so he came on wheels; of course the rivers were all frozen over in the winter at that time of the year. From Khabárovsk on to Stretensk he came by sledge up the Amur, and as he was travelling with a gold convoy he was unable to warm himself at every station stopped at, as is usually the case in Russian posting, and consequently he suffered the loss of the use of his toes. There was every possibility of his being turned out of the Service. As regards the *train de luxe*, there are two weekly trains between Irkutsk and Moscow. I can bear out what the lecturer has mentioned with regard to the electric light, the saloon carriages and everything: the whole thing is most beautifully arranged, and there is an excellent library on board with Russian, French, German, and English books, in fact the library contains some of the best literature on Central Asia that I have met with anywhere. The whole thing is most wonderfully managed. What struck me was that the administrative part of the undertaking is most excellently done, but very often the executive is not up to the mark, and they spoil what might be a very good business, by not carrying out their complete instructions. I should just like to mention that at Irkutsk in the summer, communication is kept up between the railway station and the town by means of a bridge of boats. In the winter, the river freezes over, and sledges run across on the ice. I happened to arrive in December before the river had really frozen over, and the difficulties of communication between the station and the town then were extraordinary; in fact, for two days the town was absolutely cut off from communication with the railway station, and received no mails. That is a very serious point for them. I suppose, in time, the town will be forced to build a proper bridge. I am sorry that my remarks have been so disjointed. I hoped to have received a printed copy of the lecture previously, but I only received it before entering the room, and so I was unable to follow the lecture as well as I should like to have done.

Mr. H. A. BONAR, in reply, said:—There are hardly any questions to reply to that Major Medley has mentioned, but I am pleased to have heard, and to have the experience of one who has so recently travelled over that particular route. I meant my remarks to apply particularly only to summer travelling, and I do not suppose that for some years to come winter travelling will be possible over that line; at least not to the Far East. I do not think that one need hesitate about travelling Eastward. I think the fact of coming from Central Europe and travelling on the Russian railways is as pleasant a revelation as coming from the Far East. I can say thus much for the Russian railways, that they are exceedingly comfortable, and it does not matter whether you come from the East or West, they are an improvement on the railways on either side. I am glad to hear that until the middle of December, travelling over the Siberian Railway can be so comfortable.



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THE WATER-TUBE BOILER QUESTION IN THE GERMAN NAVY.

By KÖHN VON JASKI, Marine-Oberbaurath.

(With 34 Figures and 2 Tables.)

Translation of an Article in the "Marine-Rundschau" of May, 1901.

I.—Origin of the Water-Tube Boiler Question.

THE rivalry between ships' guns and armour, and the endeavours which are constantly being made to increase the speed and extend the radius of action of war-ships, have added so greatly to the weights that have to be carried by ships, that it has become a matter of grave concern to save weight wherever it can be done, if the displacements are not to become unduly large, and the cost of construction is to be kept within the limits of the amount placed at the disposal of the constructors for naval purposes.

Up to a certain point it has been possible to lessen the weight of the guns by improved methods of construction, and the weight of the armour by making it of better material; the weight of the coal required has also been diminished by more economical engines. The use of mild steel (*flusseisen*) of greater strength has allowed of a reduction being made in the dimensions of a number of constructive details which, as a consequence, has admitted of not only the larger engines now required, but also of the hulls being built relatively lighter than was formerly possible, *e.g.*, the actual weights of the hulls of the old armoured ships, "König Wilhelm," "Kaiser," and "Deutschland," when they were built varied between 44·96 and 38·86 per cent. of their total displacements, whereas the actual weight of hull to total displacement in the new battle-ship "Kaiser Friedrich III." is only 31·64 per cent. The saving in weight, however, was still insufficient. The heavy guns of large calibre were replaced by lighter and more efficient guns of smaller calibres, and by Q.F. guns. A short 30·5-centimetre (12-inch) hooped

gun, with a striking energy of 4,680 metre-tons (15,112 foot-tons), weighed 36 tons, whereas a modern long 24-centimetre (9·45-inch) gun, with a total striking energy of 4,349 metre-tons (14,043 foot-tons), weighs only 25·8 tons; being thus 30 per cent. lighter, with a diminution of only 7 per cent. of energy. The new arrangement, moreover, allows of a greater number of guns with hydraulic training gear and a much larger amount of ammunition being put on board, so that the proportion of the weight of the gunnery and torpedo armament to the total displacement is not really less. Thus, whilst the weight of the guns in the old armoured ships "Kaiser" and "Deutschland" was 6·74 per cent. and in the "König Wilhelm" 8·21 per cent. of the total displacements, the percentages in the battle-ship "Kaiser Friedrich III." are 7·42 per cent. for the guns, and 1·05 per cent. for the torpedo armament, making a total of 8·47 per cent. for gunnery and torpedo armaments combined.

The improvements in armour allowed of thinner, and, consequently, lighter, plates for a given resistance being substituted; but, at the same time, the protection had to be increased correspondingly with the greater penetration acquired by the enemy's projectiles; the heavy guns, therefore, had to be protected by armoured turrets, the ammunition hoists had also to be armoured, and the main engines and boilers likewise necessitated the addition of protective decks; hence the weight of armour had to be considerably increased. Thus, whilst the weight of armour in the older ships was only 21·82 per cent. in the "König Wilhelm," and 23·14 in the "Kaiser" and in the "Deutschland," the percentage in the battle-ship "Kaiser Friedrich III." rose to 34·31 per cent. of the total displacement. Then, again, the demand for greater speed led to a distinct increase in the weight of the machinery installations, and to an ever-increasing percentage of the total displacement being required to meet it. Thus, the percentages of the weights for engines and boilers to the total displacements of the ships named are as follows for the older ships:—"König Wilhelm," 11 per cent.; "Siegfried," 10·9 per cent.; and "Sachsen," before reconstruction, 13·3 per cent.; as against, for the newer ships "Prinzess Wilhelm," 20·8 per cent.; "Kaiserin Augusta," 23·7 per cent.; "Jagd," 24·6 per cent.; and "Meteor," 26·2 per cent. The task, therefore, imposed upon the engine-makers for war-ships was how to obtain further economy in the weight of the machinery installations.

This demand was all the more difficult to meet, by reason of the introduction of increased expansion of the steam, which, whilst it diminished the consumption of coal, and, consequently, increased the radius of action of ships, led to the employment of high-pressure steam. This had necessarily to be followed by increased strength of all such parts of the machinery as are subject to steam pressure, more especially

in the plates of the large cylindrical boilers, all of which meant considerable increase in the weight of the boiler installations.

At first an attempt was made to obtain a large amount of steam from small boilers by forced draught, but the cylindrical and locomotive types of boilers, which were then generally used, proved but little suited for the purpose. When steaming under natural draught the layer of coal on the bars is kept thin, and the products of combustion are diluted with a large excess of air. Owing to this the temperature in the furnace is kept comparatively low. Under these conditions only a small quantity of heat per unit of time is transferred to the water in the boiler through the plates of the furnaces and combustion chambers. But, when steaming under forced draught, the fires are kept very thick, and this, together with careful stoking, allows very little more air to pass through than is theoretically required for the combustion of the fuel; consequently the temperature in the furnace is much higher than with natural draught, and a large amount of heat per unit of time is transferred to the water in the boiler through the plates of the furnaces and combustion chambers. These plates will, consequently, become much hotter than when steaming with natural draught, whilst the rigid construction of the cylindrical and locomotive boilers does not allow of the increased expansion due to the higher temperature of the plates taking place. The effect of heat on the various parts of boilers will be seen by referring to the plans of boilers shown in Figs. 1 to 4. The walls (*a*) are heated to the temperature of the steam, that is to say, with a steam pressure of 12 kilogrammes per square centimetre (170 lbs. per square inch) to 190° C. (374° F.), the walls (*b*), however, under forced draught, and with the fires properly stoked, attain a temperature of from 360° to 400° C. (680° to 752° F.) If the temperature of the furnace plates is taken as being only 370° C., the plates (*b*) are thus 370°—190°=180° C. (356° F.) hotter than the shell plates (*a*), and, consequently, with a co-efficient of expansion of 0·0000123 and a length of furnace, say, of 2,400 millimetres, would, if free, expand some $180 \times 0{\cdot}0000123 \times 2{,}400 = 5{\cdot}3$ millimetres (·209 inch) more than the boiler plates (*a*). As, however, the necessary fixing of the front end of the boiler does not admit of this large expansion of the furnace plates inside, this expansion—taking the size of the furnace box of a locomotive boiler as being 4,400 millimetres (14 feet 5·23 inches) and the thickness of the plates as 16 millimetres (·63 inch); as would be about right for ships' boilers, and the co-efficient of elasticity as 21,500—means a stress on the rivet seams (*c*) and on the tube-joints in the tube plate (*d*), which on the calculation $P = \frac{21{,}500 \times 4{,}400 \times 16 \times 5{\cdot}3}{2{,}400}$ is equal to 3,038,700 kilogrammes (3,090 tons). It is clear that no

riveted seam can withstand such a stress for any length of time, and still less the joints of the tubes in the tube plates. For this reason, the furnaces in cylindrical boilers are made of corrugated plates, which alter their form under the expansion due to the heat; the resistance, however, which a corrugated tube opposes to this change of form is still very considerable, and the stress arising in the longitudinal direction of the furnaces must be taken up by the riveted seams; whilst this expansion stress also affects the tightness of the joints of the tubes in the tube plates. As a consequence, such frequent and heavy leakages occurred in the seams (*c*) and at the tube plate that any heavy forcing of this boiler had to be abandoned.

Here again, therefore, the construction of ships' machinery soon came to a full stop, and it became a matter of necessity to drop the present system of boiler construction if a further saving in weight was to be effected.

That considerable saving in weight in the boiler installations could be obtained by substituting water-tube for the heavy cylindrical and locomotive types of boilers was well known to experts; but previous experiments which had been made with boilers of this type had invariably to be discontinued because of the disadvantages which then attended the use of water-tube boilers, and which appeared to be insurmountable. The same constructors of machinery for war-ships, who at first fought against the introduction of water-tube boilers, have, however, in the search after lighter installations, been forced step by step to give way, until now their construction is perforce being accepted in all Navies. It is true that such a decision has not been arrived at without much searchings of heart, for the constructors were well aware of the fundamental disadvantages of these boilers, and that in adopting them they would have to contend against the force of habit and the prejudices of the *personnel* against the innovation. After deciding upon their introduction there followed a series of experiments with the various types of water-tube boilers most in favour, with a view to selecting such types as were most suitable for use on board ships of war; these experiments were, of course, characterised by the sceptics as failures on the part of the constructors, whilst the cylindrical and locomotive types were proclaimed as being the only suitable types, if only they were not forced too much.

II.—Other Reasons for the Introduction of Water-Tube Boilers.

Among other reasons telling largely in favour of the introduction of water-tube boilers on board ships of war were the following :—

1. *Ability to Raise Steam Quickly.*—The cylindrical and locomotive boilers hitherto used are not only very sensitive to forced draught, but also to quick raising of steam, as their larger water capacity necessitates more coal being burnt in raising steam, because of the large amount of heat required to heat up the water; for instance, the ships of the "Brandenburg" class with the water in their boilers cold before lighting the fires, require, if there is no special hurry, and the boilers can consequently be considered, to have the fires burning for eight hours before the ships can go at full speed, and only in case of necessity can steam be raised in from three to four hours in a cylindrical boiler filled with cold water. In war-time, especially on blockading service, it will, however, often be necessary to keep the ships lying to for considerable periods, and yet to have them ready to start at the shortest notice. In order to save coal it is desirable that the fires should be out whilst the ship is stationary, but if three to four hours are required to raise steam, and before she can be ready to start, it would be necessary to keep the fires banked. According to experiments carried out by H.I.M.S. "Kurfürst Friedrich Wilhelm," during the summer of 1899, the coal consumption for this must be calculated at the rate of 200 kilogrammes per square metre (40·96 lbs. per square foot) of grate area per day, so that for a ship with twelve boilers each having a grate area of 5·85 square metres (54·7 square feet)—two boilers having steam up and ten being banked—the daily coal consumption would amount to $58{\cdot}5 \times 2.0 = 11{\cdot}7$, or roughly, about 12 tons. In order to try and diminish this heavy coal consumption, the first squadron during the same summer successfully tried the experiment of keeping the water hot in the boilers not in use, by injecting steam into the water of those at rest with the hydrokineter worked from the boilers kept under steam for driving the dynamos and auxiliary engines. To do this for five days in six boilers, the coal consumed per day was only 3·65 tons; consequently, in order to keep the water hot in ten boilers the consumption would be $\frac{10 \times 3{\cdot}65}{6} = 6$ tons per day, or just one half the amount required for keeping the fires banked. In any case, however, if the ship has to remain stationary for any considerable time, the coal consumption in a ship fitted with water-tube boilers is less than in one with cylindrical boilers. According to the experiments carried out by H.I.M.S. "Ægir," in order to raise steam in water-tube boilers with a grate area of 58·5 square metres, when the water has quite cooled down, some fourteen tons of coal are required; after lying to, therefore, for $2\frac{1}{3}$ days, there would already be an advantage in raising fresh steam in water-tube boilers rather than in keeping the water in cylindrical boilers hot by means of hydrokineters.

With cylindrical boilers where the water has been kept at the boiling point by the hydrokineter used in connection with the other boilers, it is possible to raise steam in from fifty to seventy-five minutes. With water-tube boilers steam can be raised in twenty-five minutes without endangering the boiler; it must, however, be borne in mind that large ships' engines, with their long steam pipes, after lying for some days at rest, cannot be sufficiently warmed up in twenty-five minutes to allow the engines to be started. About one hour is required after the engines have been at rest for a long time before all the parts have become sufficiently warm as to obviate all fear of water-shock in the steam pipes and cylinders. In order to be ready to start at half an hour's notice several boilers must be kept under steam, and the engines must be kept warmed even when a ship has water-tube boilers.

2. *Facility in Changing the Speed.*—Just as it is possible with water-tube boilers to raise steam more quickly than with cylindrical or locomotive boilers, so also is it possible to carry out quicker changes in the speed of the engines. Mention has already been made of the great stress on the boiler connections, *i.e.*, on the riveted seams, and on the joints of the boiler tubes in the tube plates through the expansion of the furnaces built into the outer shell of cylindrical and locomotive boilers. Of still greater danger to these connections, however, are the partial or local overheating and cooling of the furnaces, caused by the grate being unevenly covered with coal, for it is just through the alternate expansions and contractions of the plates, especially when they occur irregularly in different places, that the connections work loose. If the speed of the engines is suddenly increased, the forcing of the boilers has to be similarly suddenly increased, and then the danger becomes greater, because a higher air pressure is obtained before the grate is covered with a uniformly thick layer of coal. This is also the reason why, when forced draught is used with cylindrical and locomotive boilers, the fires have to be kept thick; whereas the less sensitive water-tube boilers are always heated with thin fires even under high forced draught.

3. *Facility in Erecting and Taking to Pieces.*—Large cylindrical and locomotive boilers are very difficult to fit in place on board and to take out again. If it becomes necessary to remove a boiler to effect large repairs in the shop, or if a boiler has to be replaced by a new one, the whole of the deck over the boiler in question has to taken up, and a very considerable disturbance of fittings takes place. On the other hand, a water-tube boiler can be taken to pieces in the boiler-room, and, after renewing any of its parts, it can be completely built up again in place.

4. *Less Danger from Explosion.*—Explosions in water-tube boilers are less dangerous than in cylindrical and locomotive boilers. If the

working of the boiler is carefully supervised, and if the boiler is subjected to regular and adequate inspection, barring extraneous causes, there is little reason to fear any defect of the plates in cylindrical and locomotive boilers, but the want of water has too often been proved to be the cause of accidents in the working of ships' boilers. When such is the case the crown of the combustion chamber becomes red-hot, and this is followed by the stays drawing out of it. If under such circumstances the combustion chamber crown does not split, such an amount of steam pours out from the holes made in it that excessive pressures take place in the furnace, and the furnace doors are blown out, and the stokers are scalded. Accidents of this sort occurred in 1892 to divisional torpedo-boat "D 5," and in 1899 on board H.I.M.S. "Wacht." With water-tube boilers, on the other hand, the cylindrical-shaped steam collectors are the highest parts containing water, and these are either not exposed to the fire or are reached only by the comparatively cooled gases. Even, however, if the plates of this steam collector, which in small tube water-tube boilers also form the tube walls, should become red-hot from a prolonged absence of water, and some of the water-tubes should draw out, the steam outlets caused thereby would be so close to the uptake that the greater part of the steam would escape through the funnel, and would only enter the stokehold if the furnace door were open. In any case the small amount of water would be quickly evaporated, and the small quantity of steam which might enter the stokehold could not be as disastrous in its effects as the steam coming from a cylindrical boiler in which the quantity of water is four or five times greater. This difference will be specially emphasised if a boiler or steam-pipe inside the boiler-room should be shot away in action. In such case the sudden escape of high-pressure steam would prevent the stop-valve to the other boilers from being closed, and the whole of the steam from the other boilers directly connected with the damaged boiler or steam-pipe would escape into the boiler-room. Even if the shot striking the boiler should not bring about a disastrous explosion involving the whole ship—as seems probable from the experience of cylindrical boilers exploding when working on shore—the large amount of steam escaping from the boilers would drive in the boiler-room bulkheads, and probably involve other parts of the ship. The disastrous effects caused by water-tube boilers with one-fourth or one-fifth the amount of steam would certainly be smaller.

III.—Disadvantages of Water-Tube Boilers.

Against the foregoing remarks telling in favour of water-tube boilers when compared with cylindrical and locomotive boilers, there must, how-

ever, be placed various peculiarities inherent to these boilers which are very inconvenient when working on board ship.

1. *Necessity for Regular Feeding.*—The advantages attending the small water chambers of water-tube boilers have been referred to in II., 1 and 4, but this small supply of water has, on the other hand, the attendant disadvantage that there is no reserve to equalise slight irregularities in the feeding, and that the rate of feeding must be very quickly altered when the output of steam from the boiler is increased, as otherwise shortness of water will occur.

Water-tube boilers consequently need very careful feeding, and very complicated automatic feed-water regulators, which must be carefully attended to and closely watched, as they often have to be adjusted by hand under varying conditions of forcing. Descriptions and drawings of these feed regulators will be found in Section 69 and Plate 51 of the 3rd Edition of "Schiffsmachine," by Carl Busley.

The regulator which is often placed in the steam collector greatly restricts the available space in the collector, and leads, if made of bronze, to galvanic action being set up, which tends to wear away the boiler plates. Even when the feed regulator is arranged outside, for which there is not always room available, the action of the float is liable to be irregular when changes are made in the rate of evaporation in the boiler. Regulating the feed of water-tube boilers by hand, however, is hardly possible because of the changing speeds of the engines and the somewhat irregular stoking of the fires.

2. *Necessity for Regular Stoking.*—Just as is the case in regard to the water spaces so also the steam spaces in water-tube boilers are small, often to the extent of being only one-fourth of the capacity of cylindrical boilers having the same amount of grate area. As a consequence the reserve of steam is insufficient to compensate for slight irregularities in the management of the fires and in the speed of the engines. In order to restrict these irregularities as much as possible a special system of stoking has been devised by which the fires are kept very thin—4 to 5 inches thick only—even when heavily forced, and regular intervals are laid down for stokers to fire up corresponding with the amount of forcing employed. The amount of coal thrown on at a time is some 1·64 lbs. per square foot of grate area; hence, if under forced draught and burning 32·27 lbs. per square foot per hour the furnaces have to be fed twenty times an hour. There is thus an interval of only three minutes between each stoking, and although but a few shovels full have to be thrown on at a time the stokers scarcely obtain any rest, and the labour is consequently very much more irksome than when longer intervals occur. Moreover, not taking into account the management of locomotive boilers on board torpedo-boats, much greater forced draught is used with

water-tube boilers as a rule than with cylindrical and locomotive boilers; hence more coal is used per foot of grate area per hour, and equally, of course, per furnace per hour, thereby exacting greater exertions from the individual stoker. As a matter of fact, this excessive labour is not so much to be laid to the charge of the nature of water-tube boilers themselves as to the fact that their construction renders possible a greater forcing of the fires.

In order to keep the fires uniformly thin, more skilled stoking is required than to keep thick fires. The *personnel* consequently needs to be specially trained in the management of water-tube boilers, and unless the stokers are properly trained full efficiency in the boilers cannot be relied upon. With a *personnel* coming fresh on board who are unaccustomed to the management of water-tube boilers, irregular working is pretty sure to occur; whereas the stokers who join the Navy from the mercantile marine are necessarily familiar with the management of cylindrical boilers.

3. *Necessity of Keeping Water Surfaces Clean.*—Any steam boiler becomes endangered if the conductivity of the heating surfaces, or of individual parts of these surfaces, is too much reduced through the fouling of the water-washed sides, for the heat impinging from the fire on the boiler walls being no longer able to pass to the boiler water causes the walls to become red-hot. The materials used in the construction of boilers when they become red-hot possess very little strength, and, as a consequence, when the walls attain this condition they are no longer able to withstand the pressure of the steam. Whereas, however, the thin tubes in cylindrical and locomotive boilers derive assistance from the surrounding water under the steam pressure, the effect of the pressure inside the thin tubes of water-tube boilers is to cause them to burst. If, therefore, fire-tubes get red-hot they become flattened, CO, and although leakage may take place at the joints of the tubes in the tube-plates, no large openings are made for the escape of the water in the boiler. On the other hand, in water-tube boilers red-hot water-tubes burst, and it is then impossible to prevent practically the whole of the water and steam in the boiler from being blown into furnace, which may lead to the stokers being scalded if the furnace doors are not kept shut. In any case, however, when a tube bursts, the water-tube boiler becomes unworkable until the defective tube can be replaced by a new one, or, in the case of small tube water-tube boilers, until the hole in the tube-plate can be stopped. The danger of explosion consequent on foulness of the inner heating surfaces is thus considerably greater in water-tube boilers than in cylindrical or locomotive boilers. There is truth, therefore, in the saying that water-tube boilers are very sensitive to impure feed-water.

4. *Difficulty of Cleaning the Water Surfaces.*—Small tube water-tube boilers are difficult to clean because the tubes are not easily accessible. Curved tubes especially cannot be examined, and it is therefore not possible to ascertain whether the tubes are quite clean inside. Large tube boilers, on the other hand, can be thoroughly cleaned and examined, but they have a large number of separate doors, and, therefore, take up much time and labour in cleaning. The numerous screwed connections also give rise to frequent repairs.

IV.—Choice of Type of Water-tube Boiler.

As soon as our naval constructors had decided, after weighing the pros and cons referred to in I., II., and III., to place water-tube boilers in our war-ships, the difficult question arose as to which of the then known types should be adopted.

1. *Rigid Constructions.*—After what has been said in I. and II. as to the great sensitiveness of cylindrical and locomotive boilers under heavy forcing of the fires, quick raising of steam, and irregularities in the management of the fires, all water-tube boilers were at once excluded whose tubes, like the fire-tubes in these boilers, are rigidly fixed between stationary water chambers. As it was a matter of rendering feasible heavy forced draught and sudden changes in the condition of the fires without risk of leakage occurring in the tube joints, there could be no question of employing the D'Allest, Steinmüller, Heine, or any other similar boilers (see Figs. 5 and 6), which may possibly be quite satisfactory water-tube boilers under other conditions of service. It is true that in the French Navy the "Charles Martel," the "Carnot," the "Du Chayla," the "Cassard," the "Kersaint," the "Jauréguiberry," the "Masséna," the "Bouvines," the "Valmy," the "D'Assas," the "Foudre," and the "Casabianca" have been fitted with D'Allest boilers, but it has been proved that they require such care in working that they are no longer being put into French war-ships.

2. *Slightly Elastic Constructions.*—Those boilers also in which either one or both water chambers can move, and so follow the expansion of the tubes, also logically appear to be excluded if straight tubes are placed between the two chambers. The tubes which are nearest to the fire—either the lowest rows, or, if the arrangement is vertical, the inner rows—will become hotter than the upper, or outer rows; and even among the tubes which are equally close to the furnace, some few will at times be hotter, from the state of the fires, than others, some of which may again possibly be abnormally cooled for the moment by the cold air entering when coal is put on; as a consequence, the length of the tubes will vary, and this must cause a stress on the tube

joints in the tube plates, because any tube which becomes shorter through cooling has a tendency to draw away from the tube plates, whilst a tube becoming longer by expansion tends to thrust itself into the plate. This to-and-fro stress on the plate causes the joints to work loose, and, as a consequence, under higher forcing and inefficient stoking, heavy leakages suddenly develop in the tube plate. For this reason, in choosing the type of boiler the Oriolle, the Watt, the Babcock & Wilcox (Fig. 7), and the Yarrow (Fig. 9), also fell out of the running.

The fact that some of these boilers—just as in the case of the D'Allest boiler—have been and are still being fitted in war-ships, proves nothing as regards the correctness of their design. Under normal conditions, with moderate forcing and proper treatment, all these boilers remain efficient. On board ships of war, however, account has also to be taken of indifferent or bad treatment; under such conditions the tubes of the Yarrow boilers on board English torpedo-boats, as well as on board the Austrian torpedo-boat "Viper," have become bent, so that now so-called "distance pieces" have had to be fitted between the tubes to keep them straight. If such occurrences must be reckoned with, and such expedients have to be adopted because the constructions of the water-tube boiler is too rigid to admit of sufficient play to individual tubes, then it would seem that all boilers liable to a similar defect are hardly to be recommended for ships of war.

3. *Absolutely Inaccessible Boilers.*—Finally, all water-tube boilers whose tubes are absolutely inaccessible for cleaning, had to be excluded as being quite unsuited to replace cylindrical and locomotive boilers in the Navy; this disposed of such constructions as those of Perkins, Herreshoff, Palmer, Ward (1885 and 1888), Du Temple (1886), Hohenstein and Bellis (1888). These boilers have been little used in war-ships, and therefore claim no historical interest in this brief account. They will, however, be found illustrated and described, with particulars of their management, in the book on the "Development of Ships' Engines in the last Ten Years," by Carl Busley, published in 1892.

4. *Types Meriting Consideration.*—After what has been said, the only kind of water-tube boilers remaining for consideration were either those in which the tubes are curved in the first instance, and which are not prevented from bending still more under expansion, without thereby causing a stress on their joints in the tube plates; or such boilers as only have their tubes fixed at one end in a water chamber, whilst the other end is free and admits of the tube expanding as necessary. If such a boiler should also have fairly large water and steam chambers, so as to obtain the advantages referred to at II. 1 and 4 without the disadvantages referred to at III. 1 and 2 becoming too prominent, then such a boiler

could be profitably used in the Navy, because it would be able to withstand high forcing without becoming leaky, and it would also bid fair, so far as leaking is concerned, to remain uninjured even if the stoking is poor.

The choice thus became restricted to the Reed, Normand (Figs. 12 and 13), the Thornycroft (Figs. 14 to 16), and the Schulz (Figs. 17 and 18) among small-tube water-tube boilers, and amongst large tube boilers to those of Niclausse (Figs. 19 to 21) and Dürr (Fig. 22). The last named could only be installed in a fore-and-aft direction, owing to the necessity for their tubes to be inclined horizontally, in order to let the steam generated in them get away freely.

V.—Fitting of German War-ships with Water-tube Boilers.

1. *Fitting of Ships with Thornycroft, Schulz, and Dürr Boilers.*—Of the boilers open to choice, those with small tubes were the lightest but difficult to inspect, whilst those with large tubes were easy to inspect, but complicated owing to the large number of doors. It was not easy to foresee which of these drawbacks would prove to be the most prejudicial on board ship, and the only course open was to build boilers of both types, and to fit up some ships with one and others with the other type, leaving the final decision as to the type of boiler to be eventually selected for general use in the Navy to depend upon the results obtained after the various systems had been thoroughly and practically tested. To fit up an experimental ship with various kinds of water-tube boilers was not admissible because, on the one hand, any conclusions so arrived at as to the suitableness of a given boiler for use on board ship would have been still open to question, whilst, on the other hand, the introduction of water-tube boilers could no longer be deferred if we were to compete with other countries, all of which had already adopted them, and thereby obtained increased speed in their ships together with a diminution in the weight of machinery. Nor, finally, could the construction of boilers for the new ships be postponed pending the result of the steam trials of the ships first fitted with water-tube boilers; hence it has come about that during the last six years a number of ships have been fitted with boilers of both kinds, small tube and large tube, without, up to the present, any definite conclusions having been arrived at as to the selection of the future type of water-tube boiler.

The trials in 1893 of the Thornycroft boilers fitted on board the English torpedo-gunboat "Speedy" had already favourably drawn the attention of the German Admiralty authorities towards small-tube boilers. Amongst the types of foreign design belonging to this class available for

selection—the Reed, Normand and Thornycroft — the last-named was preferred, but an order was at the same time given for a Schulz boiler, because this latter seemed to promise certain advantages over the Thornycroft which had already been tried.

As regards large tube water-tube boilers these were first tried in 1895 on board the mining-ship "Rhein," for which the Dürr firm at Düsseldorf had constructed a boiler. The results obtained from this boiler were certainly hardly satisfactory; its efficiency proved to be no greater than a cylindrical boiler, it gave wet steam and was inaccessible for cleaning of the fire surfaces. On the other hand, steam trials which were carried out at Düsseldorf, in the summer of 1896, with a new and improved Dürr boiler gave such good results in every respect that it became possible to proceed with the construction of such boilers for use in war-ships.

The following water-tube boilers have thus been ordered for the German Navy during the last few years:—

In 1894—

1. Thornycroft boilers for H.I.M.S. "Ægir," and for torpedo-boat S 74.
2. Schulz boilers for torpedo-boat S 42.

In 1896—

1. Thornycroft boilers for torpedo-boats S 82 to S 87, and for divisional torpedo-boat D 10.
2. Thornycroft boilers in conjunction with cylindrical boilers for H.I.M.S. "Kaiser Friedrich III."
3. Schulz boilers for torpedo-boats G 88 and S 89.
4. Dürr boilers for H.I.M.S. "Baden."

In 1897—

1. Thornycroft boilers for the gun-boat "Iltis."
2. Schulz boilers for H.I.M.S. "Württemberg."
3. Dürr boilers for H.I.M. ships "Bayern" and "Vineta."

In 1898—

1. Thornycroft boilers for the gun-boats "Jaguar," "Tiger," and "Luchs," for the small cruiser "Niobe," for the armoured coast-defence ships "Hagen" and "Beowulf," and for torpedo-boats S 90 to S 101.
2. Schulz boilers for the small cruiser "Nymphe."
3. Schulz boilers in conjunction with cylindrical boilers for H.I.M. ships "Fürst Bismarck," "Kaiser Wilhelm II." and "Kaiser Karl der Grosse."
4. Dürr boilers for the large cruiser "Victoria Luise," and for the armoured ship "Sachsen."

In 1899—

1. Thornycroft boilers in conjunction with cylindrical boilers for the battle-ship "Barbarossa."
2. Schulz boilers for the small cruisers "Thetis," "Ariadne," "Medusa," and "Amazone," and for torpedo-boats S 15, S 16, and S 37.
3. Schulz boilers in conjunction with cylindrical boilers for the battle-ships "Kaiser Wilhelm der Grosse," "Wittelsbach," and "E."

1900—

1. Thornycroft boilers in conjunction with cylindrical boilers for the battle-ship "D."
2. Schulz boilers for gun-boat "A," and for the armoured coast-defence ships "Heimdall," and "Hildebrand."
3. Schulz boilers in conjunction with cylindrical boilers for the battle-ships "F" and "G."
4. Dürr boilers for the large cruisers "Prinz Heinrich," and "B."

On the one hand, it will thus be seen that the Thornycroft boilers are being gradually pushed aside by the Schulz boilers; and, on the other, that up to the present no decision has yet been come to fit the large battle-ships with only water-tube boilers, but a mixed system of cylindrical and of small-tube water-tube boilers has been chosen for them. By this selection the boiler installations have been kept as light as when only cylindrical boilers were used, and yet, while account has been taken to some extent of the prejudice against water-tube boilers from their difficulty of management and their sensitiveness, the good points of both systems have been united in one and the same ship. To meet the case of defective condensers and impure feed-water there are the relatively less susceptible cylindrical boilers, and to meet the need for raising steam quickly and forced draught there are the relatively less susceptible water-tube boilers. Water-tube boilers had at first, and still have, the reputation of burning more coal for the same power than cylindrical boilers, especially if running continuously over long distances. The large battle-ships, in which the need for saving weight was not of so pressing a nature as in the large cruisers and gun-boats, with their combination of boilers, will consequently be enabled, when steaming at "ordinary" speed on long runs, to use the more economical cylindrical boilers.

If in course of time water-tube boilers should prove themselves to be as economical as cylindrical boilers, and also as entirely safe to use, if by any chance it might become necessary to feed them for some days with

brackish water, there will no longer be any impediment to fitting large battle-ships exclusively with water-tube boilers, and it will be possible in this class of ship also to effect an important saving of weight.

The following are the names of the French war-ships which either have been, or which still are, provided with Niclausse boilers: — "Suffren," "Marceau," "Henri IV.," "Condé," "Gueydon," "Kléber," "Requin," "Friant," "Fleurus," "Téméraire," "Zélée," and "Décidée."

The design of the Belleville boiler (Figs. 23 and 24) does not comply with the requirements which have been laid down here at IV., 4.[1] In this type of water-tube boilers the large tubes have one end attached to a steam collector, the other ends, however, are not arranged free but open out into small water chambers which receive the feed-water, and for this purpose are attached to a common tube. The tubes rest with the lowest back row of their junction boxes on the boiler supports by means of rollers which in a measure form movable feet to the boiler. The water-tubes themselves consist of straight tubes screwed into junction boxes and arranged in zig-zag order. There is thus the possibility of an expansion of the tubes if the cylindrical steam collector is somewhat lifted from the tube system. The circulation, moreover, necessitates having an exceptionally low level of water, the water capacity is therefore very small and the disadvantages in connection with water-tube boilers, referred to at III. 1, are especially marked in this boiler. Besides, this boiler could not be forced to any extent, and it had to be worked at a very high steam pressure, which was reduced in the pipes on its way to the engines by some five atmospheres, as otherwise the steam produced was hardly sufficiently dry.

2. *Trial of Niclausse and Belleville Boilers.*—As will be seen from the foregoing list, speaking generally, two systems of water-tube boilers are in use in the German Navy: First, the Thornycroft and the improved Thornycroft—the latter being represented by the Schulz, and, second, the Dürr boilers. The fact that the other great naval Powers showed a preference for other types caused the German naval authorities to experimentally fit up a few ships with these other types in order to be able to compare them with those which the German constructors considered to be the best kinds of boilers. As a consequence the Schiff- und Maschinenbau-Aktien Gesellschaft Germania were ordered in the winter 1895-6 to supply H.I.M. large cruiser "Freya" with Niclausse boilers, and Belleville boilers for the large cruiser "Hertha" were ordered from the Stettiner Maschinenbau-Aktien Gesellschaft Vulcan. About a year

[1] Compare the report of the English Water-Tube Boiler Committee, which appeared on page 488 of the April number of the *Marine-Rundschau*, observing that this paragraph was already in the press when the report of the Committee was published.

later Niclausse boilers were ordered for the small cruiser "Gazelle," and Belleville boilers for the large cruiser "Hansa."

In principle the design of the Niclausse boiler is similar to that of the Dürr boiler, but it differs considerably from the latter in matters of detail, and that, as will be seen later, not to its advantage. At that time, according to reports appearing in the French newspapers, such good results had been obtained from Niclausse boilers on board the protected cruiser "Friant" in France, and in England on board the torpedo-gunboat "Seagull," that the French Admiralty decided to equip quite a number of large ships with these boilers.

The following ships are, or were, fitted with Belleville boilers:—

In England: "Sharpshooter," "Powerful," "Terrible," "Diadem," "Arrogant," "Furious," "Gladiator," "Andromeda," "Europa," "Niobe," "Vindictive," "Amphitrite," "Argonaut," "Ariadne," "Spartiate," "Hermes," "Highflyer," and "Hyacinth."

In France: "Isly," "Descartes," "Pothuau," "Charlemagne," "Pascal," "Bouvet," "Gaulois," "Saint-Louis," and "Galilée."

3. *Trial of Yarrow and Normand Boilers.*—In order to leave nothing uninvestigated, the German Admiralty in 1896 and in 1899 gave orders for torpedo-boat S 32 to be fitted with Yarrow boilers and for divisional torpedo-boat D 3 to be fitted with Normand boilers.

VI.—Experiences with Water-Tube Boilers.

1. *With Small-Tube Boilers.*—The trials of the Thornycroft boilers on board H.I.M.S. "Ægir," and on board torpedo-boats S 82 to S 87, and also of the Schulz boilers in torpedo-boats S 42, G 88, and G 89, were on the whole satisfactory, and especially demonstrated the superiority of this boiler over the locomotive boilers with which the ships of the "Ægir" class and the torpedo-boats had hitherto been fitted, in so far that the boilers remained in good condition under any kind of forcing and treatment of the fires. The fear that the small tubes, when impure water was used, would become obstructed and then get red-hot and burst was, however, justified. As a water-tube in a Dürr boiler on board H.I.M.S. "Baden" also got foul with scale and grease, thereby causing it to get red-hot at a weak place and burst, orders were issued that all water-tube boilers should be filled and fed with distilled water only, and other measures were adopted to prevent the accumulation of harmful greasy deposits on the inner surfaces of the tubes. The evaporators for all ships fitted with water-tube boilers were made of such dimensions that, under any circumstances, distilled water only could be used for boiler "make-up" feed; feed-water filters were also inserted in the delivery pipes of the air pumps, and into the delivery pipes of the feed pumps,

and measures were likewise taken to keep soda constantly mixed with the feed-water. Since the introduction of these expedients no bursting of tubes has taken place either in the small tube water-tube boilers or in the Dürr boilers.

The fact that the small water chambers serve as bottom-tube plates to the outer rows of tubes at first greatly impeded the cleaning of the insides of the tubes of the "Daring" type of Thornycroft boilers; in the original Thornycroft boilers fitted on board divisional torpedo-boat D 10 their internal diameter was only 6 inches; the diameter of these water chambers has lately been increased to between 15 and $17\frac{3}{4}$ inches, so that they can now be easily examined.

The cleaning of the insides of the small water-tubes was further greatly impeded by the ends of the tubes being tapered to a less diameter than the body of the tubes, in order not to weaken the tubes' plates too much and to enable the tubes to lie closer. This is now no longer the case, and the following method of cleaning has accordingly been laid down. As a rule, a frequent scouring of the boiler with soda and blowing out the soda solution, which carries with it the loosened grease and dirt, is sufficient; after which the tubes are washed out from the steam collector with water under pressure. Once every year, however, the same special inspection and thorough inner cleaning as is prescribed for cylindrical and locomotive boilers is to be undertaken; the instruments shown in Figs. 25 to 27 being used for the purpose. These consist of small steel brushes of the shape shown in Fig. 25, and scrapers made of watch springs (Fig. 26), which are drawn through the tubes by steel wire cords—using for the purpose the friction roller arrangement shown in Fig. 27—and so scrape off the deposits adhering to the inner walls of the tubes. This cleaning is carried out by one petty officer and five stokers in 200 hours, that is to say, 20 days of 10 working hours, and is sufficient, so far as the experience hitherto obtained with forced draught in torpedo-boats goes to show, to prevent any irregularities in the working of the boilers. Less thorough cleanings have been carried out on board the "Württemberg," after 700 hours' steaming in 8 days.

On board the gun-boats "Iltis" and "Jaguar" also—the "Iltis" has already been in commission for more than two years, and for most of the time under unfavourable conditions—irregularities in working have only been reported in a single case, where it was clearly shown that the cause was attributable to want of water; in this case in the boiler concerned the joints of the tubes in the steam collector tube plates leaked.

One defect noted in the Thornycroft boilers on board torpedo-boats S 82 to S 87 was attributable to the short distance which the hot gases pass over among the tube rests on the way from the grate to the uptake.

Under forced draught the flames shoot up above the short funnels, and the boats consequently are visible at long distances by night. If the funnels are raised, the flames no longer issue from them, but the uptakes become so heated that economical working cannot be expected. In the Schulz boilers, which are really in essentials improved Thornycroft and Normand boilers, this inconvenience is obviated by arranging the tubes in single rows, and so making them to serve as guide walls to the hot gases, which are thus made to travel such a long distance among the tube nests, that they give up sufficient heat to the water as to prevent the formation of flames in the funnels whilst also ensuring good utilisation of the gases. As regards coal consumption, when travelling at a speed of 12 knots, the consumption on board torpedo-boat S 83 was 2·2 lbs., and on board divisional torpedo-boat D 10, 2·64 lbs. per I.H.P. per hour, both being fitted with Thornycroft boilers; on the other hand, the consumption on board G 88, which is fitted with Schulz boilers, was only 1·59 lbs., or just 28 per cent. less than the amount of coal consumed on the similar sized torpedo-boat S 83; the heat registered in the funnels of the Thornycroft boilers was 700° C. (1,292° F.) as against from 412° to 425° C. (773° to 797° F.) in the funnels of the Schulz boilers.

The Thornycroft, and also the first Schulz boilers, had the disadvantage that when preserved full of water, which is generally advisable when the boats are being kept ready for service, all the air could not be expelled from the upper bends of the water-tubes. In the Thornycroft boilers, where the tubes discharge above the water level in the steam collector, this inconvenience cannot be remedied; the Schulz boilers, however, are now so constructed that the highest part of the upper bends in the tubes do not lie higher than the openings into the steam collector, and this arrangement consequently obviates the inconvenience in question.

The fear at one time expressed, that the water circulation in the tubes when working at a moderate rate would be so small that some of the tubes would become red-hot and burn through, has hitherto proved groundless. The tubes put into the Thornycroft boilers of H.I.M.S. "Ægir" four years ago, even the top ones lying nearest the steam collector, have their ends, which are expanded in the tube plate, still in good condition. These ends are, however, rusted inside, and this must be attributed principally to the galvanic action arising from the brass baffle plates originally fitted, and from the bronze feed regulators arranged inside the steam collectors with the copper feed and steam pipes. The harmful effects of galvanic action on the steam collector and generating tubes will, in future, be obviated by making these fittings of iron and steel.

At first, the tubes in the boilers of torpedo-boats S 74 and S 82 to S 87, suffered rapid deterioration from the outside, but since greater attention has been paid to keeping the ends of the tubes dry, especially the lower ones lying next to the water chambers, which become covered with dirt, the tubes have remained sound. On board the "Ægir," the zincking on the outside of the tubes has worn off completely after four years' service, but the thickness of the tubes has not perceptibly diminished. These tubes in the Thornycroft boilers of the "Ægir," in consequence of this diminution in the strength of the upper short ends, are now to be renewed; as, however, the tubes are otherwise sound, the long tubes are to have their ends cut, and after re-zincking will be replaced and again used as shorter tubes, so that out of 3,300 tubes only 900 require to be replaced. This repair is necessary in order to ensure the boiler working reliably for some years, but in the event of war the tubes could have been left in the boiler in their present condition without any danger.

If the same experience obtains as to the life of the tubes in the latest Schulz boilers, it may be assumed that these boilers will require re-tubing every four years; it is, however, probable that by utilising the experience acquired in the meantime, the lives of these boilers will be considerably prolonged. In any case, it should not be overlooked that the tubes in cylindrical and locomotive boilers require to be renewed after about five years' wear.

Speaking roughly, the probable serviceableness of the latest Schulz boilers should not be judged from the experience gained with the first, and in many respects imperfect, boilers of this and of the original Thornycroft types. In any case, however, the duration of life of the improved Schulz boilers is as yet unknown, and the distrust of the opponents of small-tube boilers to the durability of the tubes in this boiler is explicable if they reckon on having to meet the enemy with ships whose tubes are from four to five years old. The thickness of these tubes, as with all other water and fire-tubes, can only be ascertained by taking out and cutting up certain specimen tubes. This test is applied once a year, the same as it is to cylindrical and locomotive boilers which have iron tubes, under the instructions for the inspection of boilers already referred to, and so far this inspection has sufficed to prevent the tubes bursting after becoming thin. It must be remembered that the stress on the material of the small water-tubes is only from 0·48 to 0·65 kilogramme per square millimetre (682·7 to 924·5 lbs. per square inch), which is only about $\frac{1}{50}$th of the ultimate strength of 34 kilogrammes per square millimetre. Any ordinary wasting of the material of the tubes caused by rust and wear can therefore hardly bring about the bursting of a tube. The only things detrimental to the durability of small tubes is

the scale developed on their inner surfaces as referred to at III. 3. It would therefore be desirable if a system of inspection could be introduced, which would admit of its being possible to ascertain whether the inner surfaces are clean enough to obviate any anxiety being felt in regard to the possibility of the tubes becoming choked when the boilers are worked for prolonged periods. Up till now scale alone has not caused any bursting of small tubes, this having only taken place from a complete stoppage in the tubes; this is easily explained by the fact that even with the reduction of conductivity to heat, the tubes do not become so hot that their diminished strength renders them incapable of withstanding the comparatively small strain thrown upon them; only complete cessation of the water circulation apparently brings about this excessive heating of the tubes. An inspection of the inner heating surfaces of the small tubes in the Thornycroft and Schulz boilers is, however, only possible by passing a steel wire brush through each separate tube, which is obviously an inconvenient and lengthy proceeding; if the brush can pass, then it is clear that there is no great fouling or formation of scale, but beyond this nothing further is conclusively proved. Time alone will show whether the formation of scale on the inner surfaces of the tubes will still continue when using distilled water only for the feed, and the measures now adopted for filtering the feed water and keeping it alkaline with soda. Up to the present such has not been the case; but account will always have to be taken of the possibility of leaky condensers and consequent brackishness of the boiler water. If, even with leaky condensers, injurious deposits of scale do not take place, then the inspection of the inside of the curved water-tubes by viewing can be dispensed with, and the examination of the tubes can be limited to the yearly special survey and to cutting up certain tubes as samples; in such case these boilers could then be considered as quite safe for working. So long, however, as this has not been definitely established, the engineer in charge would do well, if any defect or leak should manifest itself in the condensers, to frequently change the boiler water and to clean and refill the boilers not in use. Under such circumstances it would be inadvisable to undertake a long run at high speed with all the boilers working, until the defect in the condensers had been remedied.

The opponents of small tube water-tube boilers specially put forward the assertion that the captain cannot be responsible for the engineers having the boilers clean at any moment, and, consequently, in a state of readiness for war. On this point it is to be observed that locomotive boilers which the engineers in charge had considered to be sufficiently clean became completely unworkable for a considerable time in a trip between Wilhelmshaven and Kiel owing to leakage at the tube-plates, which, on a closer inspection of the boiler being made by removing

some of the tubes, proved to be due to the ends of the tubes being covered with a thick crust of salt close to the tube-plates. This incident occurred some five years ago on board H.I.M.S. "Beowulf." The case, however, in which cylindrical boilers became unworkable because of their tubes becoming encrusted with salt, or scale, are not infrequent. It may be conceded that cylindrical boilers do not become dangerously oversalted as quickly as water-tube boilers.

The cleaning of the exterior of water-tubes is carried out by means of compressed air from the air blowers, and is no longer attended with difficulties.

2. *With Dürr Boilers.*—The experience with Dürr boilers has also proved so far successful that the boilers have shown themselves to be unaffected by heavy forcing and to sudden changes in the draught. The solitary case of a tube bursting through extensive fouling has already been mentioned at VI. 1. Dürr boilers are heavier than small-tube water-tube boilers, but they possess an advantage over the latter type in the ease with which the cleanliness of the inner surfaces of the tubes can be ascertained. It is true, however, that in respect of this inspection, if it is to extend to all the tubes, an enormous number of doors, one at least for each tube, have to be opened out and closed again, which necessarily takes up much time and labour, more especially so, as the inner tube of each generating tube has to be taken out and replaced. Practical experience has, however, shown that it is principally the lowest tubes which foul, and as a rule, therefore, it is only necessary to examine the three lowest rows of tubes, and if these are found to be clean the upper rows need not be examined. But in order to carry out a thorough cleaning of the boiler the whole of the tube-hole doors, both at the front and back, must be opened, and this means for a ship like the large cruiser "Prinz Heinrich," which has 14 boilers with 574 water-tubes in each, the removal of $2 \times 14 \times 574 = 16{,}072$ doors. An extensive cleaning of the boilers takes place after each steaming period of from 700 to 1,000 hours. On such occasions all the tube-hole doors are opened and each outer tube is scraped and washed. All the inner tubes are also swept with steel brushes and washed out inside. Such a cleaning, necessitating the opening up, cleaning, and closing again of the boiler, takes up the time of two petty officers and ten stokers for 38 hours for each boiler, which makes four days of ten working hours for each.

The original construction of the back tube stoppers, which is very solid and absolutely safe, greatly hindered the work of cleaning, because as will be seen from Fig. 28, the inner conical plug had to be pulled out to the front of the boiler, and after the tube was cleaned the plug had to pushed in again to the back end of the tube. Recently, however, the back

closing arrangement has taken the form of a cap nut, as shown in Fig 29. This closing arrangement having been experimentally tried on some of the tubes in the "Victoria Luise" and "Sachsen," and having been found to answer, the tubes in the Dürr boilers of the "Prinz Heinrich" and of the large cruiser "B" are closed with the new cap nuts. The time required for cleaning the boilers will be materially shortened by this improvement. These cap nuts are made of wrought bronze of great strength, and have V section ridges turned on the face for making the joint instead of the conical threads used with the cap nuts of Niclausse boilers.

In the later Dürr boilers the water chambers extend farther below the lowest row of tubes and form a sediment chamber; it may be assumed, therefore, that the tubes will in future be cleaner, and that the intervals between the thorough cleanings of the boilers will be longer. Presumably also, ships, even on foreign service, fitted with the latter boilers, will only need to have their boilers thoroughly cleaned twice a year, provided that the condensers do not leak; as bearing upon this the condensers will in future, perhaps, prove more reliable now that their tubes are to be made of stronger material. If the condensers are leaky and the boiler water becomes brackish in consequence, the boilers prime heavily, especially if the water at the same time contains soda. However, these boilers have not proved themselves to be so greatly affected by being fed with brackish water as was feared by many persons. On board the "Sachsen" a Dürr boiler was at work continuously on harbour service for some days with feed water containing 10 per cent. of salt without any of the tubes becoming heated. Salt scale, especially at the back ends of the lowest water tubes, 2 millimetres (·079 inch) thick, which has been formed in this way, has had no injurious effect. The stress on the material is also relatively small in the tubes of these boilers, and the margin of safety is high.

Great care must be taken in preserving the inner tubes, which are made of quite thin mild steel plates, and the super-heater tubes. The boilers should either be preserved by the wet method, *i.e.*, by keeping them quite full of water, or by the dry method, when they are not in use. If by chance the boiler water is blown out through the blow-off cock, and the tubes are not at the same time emptied—as happened when the "Victoria Luise" was first put out of commission—the upper ends of the inner tubes are deprived of water, and being surrounded with damp air quickly rust. At first the tubes used to be emptied by syphoning from the front; but lately the practice on board the "Sachsen" has been to loosen the back conical tube stopper. The new style of closing by means of cap nuts will still further facilitate emptying the tubes. In the opinion of the captain of the "Sachsen" the introduction of this

closing arrangement will enable a complete change of water to be affected in a Dürr boiler in from three to four hours. The thin tubes in the super-heater, similarly to the inner tubes, are liable to be injuriously affected by damp or air unless the boiler after ceasing to work is either kept quite full or quite dry. Hitherto the system of design made it difficult to completely fill the super-heater tubes; but in the boilers now being built this inconvenience is being remedied by providing means of exhausting the air from them.

The back walls of the Dürr boilers necessitated constant repairs. The tubes which are fixed in the tube plates of the water chamber by thickened and skewed cones lie with their back ends free in a latticed wall, the openings in which serve at the same time to help the cleaning of the tubes, which is carried out by means of forced draught from the boiler-room. These openings are closed with plates lined with asbestos pulp, which are fastened to the lattice-work by pins and cottars. These plates, however, become warped and often burnt by the heat, so that labour is entailed in straightening or replacing them. The side wall casings, as in all water-tube boilers, also suffer from the heat, because the outer rows of tubes, which form the external wall of the furnace, can never be kept quite tight, and yet all these casing plates have to be as thin as possible to keep down the weight of the boiler. The cleaning of the fire side of the outer tubes, which at first occasioned trouble, can now be carried out in a simple manner, even whilst the boiler is working, by forcing air, under pressure, through from the ventilating fans, with the ash-pit doors closed and the furnace doors open. The air passing over the fire into the furnace blows most of the soot which is lying on the tubes out through the funnels. This soot has been the principal cause of the economy of the Dürr boilers having hitherto, when running for long distances, been less apparent than it was on the official acceptance trials. It may, however, be taken for granted that this inconvenience will not in future make itself felt to the same extent if the furnaces, when making long runs, have air blown through them. When a thorough cleaning is to be made, with the boilers cold, the air, as already remarked, will be blown through the lattice-work into the tube nests, the back-casing plates being removed singly for the purpose as necessary. With a view to more effectually removing the soot which collects on the baffle-plates used for directing the course of the gases, a shaking arrangement has lately been fitted to the baffles. The Dürr boilers have thus either been, or are being, improved as a result of the experience gained from their working on board ship. At first the consensus of opinion was undoubtedly against these boilers, because so much work was occasioned in the handling and keeping in order of the numerous doors, and because of the constant exertion entailed upon the

boiler-room *personnel*. These boilers, however, should not be judged by the experience of the first types alone, but judgment on them should be suspended until experience has been obtained with the later types. It may be said, however, that even the present opponents of this system appreciate its advantages in regard to facility of inspection, and do not counsel its abandonment. It has recently been decided to build more of these boilers, and that the large cruiser about to be constructed to replace the "König Wilhelm" should be fitted with Dürr boilers.

3. *With Niclausse Boilers.*—The experience of the German Navy with Niclausse boilers has so far been very unsatisfactory. In October, 1898, the small cruiser "Gazelle" and the large cruiser "Freya," both of which are fitted with Niclausse boilers, made their first trial trips, and it was not until April, 1901, that the "Gazelle" could be commissioned with serviceable boilers, and that the "Freya" could continue her interrupted trials. The interval was taken up in making repeated alterations in the boilers.

The most serious defect in this boiler is attributable to the large use made of malleable cast iron, a material which should be altogether excluded in boiler construction. This material is cast iron, to which greater strength than is possessed by ordinary cast iron is imparted by heating it without air in a layer of coal dust. The resulting material is not so brittle as cast iron, but is not equal in tenacity to wrought iron, and already in consequence of the strains set up in cooling after the casting, easily bursts.

Immediately after the first trials cracks were noticed in the malleable cast iron headers and lanterns (see Figs. 21, 30, and 31). The cracks in the headers, which were in the diaphragm and extended from one tube-hole to another, were not dangerous; those which ran in the direction of the outer walls could for the most part be drilled and made harmless, so that the water chambers could, at least for a time, be considered as safe to work. The lanterns, however, were all replaced by others made of mild steel (compare Figs. 32 and 34), because the complete fracture of both webs of a lantern would be followed by the breaking off of the dog of the tube-hole door—at that time still made of malleable cast iron—which would have dangerously imperilled the lives of the stokers in the boiler-room.

The long drawn-out negotiations between the Admiralty and the contractors for the engines, the Schiff- und Maschinenbau-Aktien-Gesellschaft Germania, and between this latter company and the patentees of the boiler, the Niclausse firm in Paris, as well as the preparation of a large number of new lanterns, and fitting them in the boilers took a very long time; finally, however, when after an interval of two years the "Freya" was able to recommence her trials one of the outer tubes burst,

and the back cap nut of another outer tube stripped off. On inspecting the boiler a large number of tubes were found to be considerably bent upwards, and, from the appearance of the tubes, it was evident that they had been red-hot. The only reason for the tubes getting red-hot must have been from want of water, but as the gauge glasses during the run indicated a sufficiency of water the deficiency in the tubes must have been due to defective circulation. This view was borne out by the fact that during the trial-run the ship was considerably out of trim and that the greatest bending in the tubes and the bursts which occurred in two separate boilers took place in those boilers where tubes had assumed a more horizontal position than their customary angle of inclination owing to the ship's want of trim.

On examining the front part of the headers it was seen that in some cases the ports in the lanterns between the webs and through the holders of the inner tubes were somewhat small, and in others that the lanterns had too great an amount of play in the diaphragm plate in the headers, so that a portion of the water entered the back part of the headers without passing through the inner tubes. The construction of the lanterns, as may be seen from Figs. 32 and 33, did not admit of a further weakening of the webs; it was to be assumed, however, that the ports in the lanterns would be large enough if the lanterns were arranged in the headers in such a way that ports in the lantern and the holder for the inner tube were turned so as to lie up and down, and if the play in the diaphragm were reduced to a minimum by a thickening of the lantern at this point. From a trial made during a six hours' run with a boiler altered in this way in H.I.M.S. "Freya," with the ship properly trimmed and with forced fires, *i.e.*, with a consumption of 170 kilogrammes of coal per square metre (34·8 lbs. per square foot) of grate area per hour, this surmise was proved to be correct, and the whole of the boilers in the "Freya" and "Gazelle" were altered accordingly. The tubes in the Niclausse boilers have an inclination of 6° to the horizontal; in the trial run on board the "Freya," when the accident took place, this inclination was diminished to about 5°. At the time of the accident the webs for the most part were arranged up and down and the holders for the inner tubes lay below and so covered the lower ports underneath. In the trial referred to, the webs and holders were arranged as shown in Fig. 32. With this arrangement the circulation of the water proved sufficient even under unfavourable trimming of the ship. As was shown by the experiments carried out by Professor Gutermuth with the Dürr boiler, the circulation of water, when the tubes have as small an inclination as only 1° to the horizontal, is sufficient to prevent the tubes from getting red-hot. Moreover, it should be borne in mind that the flow of water from the water chamber into the inner tubes is much less impeded in the Dürr boiler

than in the Niclausse boiler. It goes without saying that it is an essential requirement in ships' boilers that they should be able to stand changes in the trim of the ship without ill-effects.

Similar accidents to the one which occurred on board the "Freya" have also taken place in the Italian armoured cruiser "Garibaldi," which is fitted with Niclausse boilers. The French Press have not allowed any accidents to Niclausse boilers to become known; it may, however, be surmised that such must also have occurred on board French war-ships, since Niclausse has given up the less reliable, but cheaper, malleable cast iron, and now fits his boilers exclusively with the much more expensive mild steel (*flusseisen*).

It should further be mentioned that in some pressure trials of water-tubes, carried out after the substitution of mild steel lanterns for the malleable cast-iron lanterns, a large number of the cap nuts, also made out of malleable cast iron, used for closing the back ends of the tubes, burst; it is probable that they were screwed up on the conical threads with too much force. In consequence of this experience all the cap nuts were replaced with others of mild steel.

Even after making these alterations, the design of the Niclausse boilers still gives rise to a certain amount of danger in so far that some amount of stress is present which tends to lift the tubes from their seatings in the headers and to force them out of the headers towards the firing space. Under normal conditions, this stress is taken up by the friction in the conical seatings and by the dogs on the front walls of the water chambers, each of which holds two tube doors, and which are secured to the malleable cast-iron headers by means of studs and nuts. If at any time, however, any of the tubes show signs of leakage, it is very convenient for the stokers to screw down the nuts on the studs of the dogs and thereby to put a stress on the tubes, which may easily cause a stud to draw out of the thread in the malleable cast iron; if this occurs, then the two tubes concerned are only retained in the boiler by the friction in the conical seatings. In the Dürr boiler the tubes are forced against the conical seatings by the pressure of the water, and the hand-hole doors in the front tube plate are absolutely secure from any danger of flying out because the openings in the tube plates, into which they bed, are coned, with the large end inside.

This element of safety (see Fig. 34) serves, to some extent, as a set-off to the difficulty experienced in removing and replacing the hand-hole doors.

How the fine-cut threads are likely to last time alone will show. In Germany, such threads have hitherto only been used in telescope making, but never in boiler construction. On board H.I.M.S. "Gazelle," where some of the fittings of the blow-off cocks on the front of the water

chambers are screwed with similar fine threads, they have hitherto leaked continually.

The attachment of the headers to the steam collector also can hardly be considered as being solid: some of the studs broke off, even when the boilers were being erected.

After these experiences, and after a critical examination of the details of design, there is no reason why we should exchange the proved solid construction of the Dürr boiler for that of the Niclausse boiler, especially when all that has been adduced against the Dürr boiler at VI. 2 is also to be met with in the Niclausse boiler, and when the details of design in which the Niclausse boilers differ from the Dürr boilers compare unfavourably with similar details in the Dürr boiler.

4. *With Belleville Boilers.*—The Belleville boilers without economisers, as fitted on board H.I.M. ships "Hertha" and "Hansa," have the reputation of being very uneconomical, and it is partly for this reason that this type of boiler is being given up in England. The coal consumption in the acceptance trials of the "Hertha" and "Hansa" was, on the average, 1·98 lbs. per I.P.H. both for the continuous full-power trials and for the ordinary speed trials, and consequently does not compare unfavourably with many of the runs made with cylindrical and locomotive boilers, or with other types of water-tube boilers; especially considering the moderate forcing of the boilers with a coal consumption of from 16·69 lbs. to 17·56 lbs. per square foot of grate area per hour for the full-power trials, and of from 8·35 lbs. to 8·6 lbs. for the ordinary speed trials.

When H.I.M.S. "Hertha" went out to the China station the mean coal consumption of ten continuous hours at ordinary speed was 13·5 lbs. per square foot of grate surface per hour, which is equal to a consumption of 2·9 lbs. per I.P.H. per hour; on some runs, with 4,600-I.P.H., the consumption was 2·8 lbs. per I.P.H. On the other hand, from a report sent in by the captain of the "Hertha," it appears that on a previous occasion, after the boilers had been thoroughly cleaned and the engines had been overhauled, during a 24-hours run at ordinary speed and with a coal consumption per hour of 11·67 lbs. per square foot of grate surface, the consumption per I.H.P. was only 1·79 lbs. per hour. According to the newspapers the English cruiser "Europa" was said to have consumed during her contractors' trials, when her boilers were new and clean, only 1·54 lbs. of coal per I.H.P. per hour, whereas later, when going at ordinary speed, the consumption rose to 4·85 lbs. per I.P.H. It appears, therefore, as if these boilers foul very much when working continuously, and, consequently, become uneconomical.

During the construction of the boilers for the "Hertha" and "Hansa" much stress was laid by the makers in having Serve tubes for

the lowest rows, which are those most exposed to the fire. Such tubes, however, at that time could only be made by welding, and three of them burst at the welds when the boilers were being worked. Even with only three burst tubes out of a total of 792 welded tubes—barely 0·4 per cent. —the possibility of further bursts taking place, entailing probable injury to the stokers, was considered too serious a risk to be incurred, hence the whole of the Serve tubes have now been replaced by ordinary seamless tubes. Although the effect of this alteration was to diminish the steaming efficiency of the boilers, it increased the safety of working.

Similar unfortunate experiences attended the working of Belleville boilers in the English Navy; here also the welded Serve tube have been replaced by seamless tubes.

Allusion has already been made at V. 2 to the disadvantage possessed by these boilers as compared with other water-tube boilers by reason of their unusually small water capacity, and the consequent introduction of reducing valves in the steam pipes. These reducing valves have often given rise to trouble when steaming. Moreover, the use of high-pressure steam necessitates comparatively great strength in the materials of the steam pipes, and consequently requires heavy pipes because the reducing valves are not reliable, and the strength of the pipes even beyond the reducing valves require to be calculated for the higher steam pressure.

Above all, however, these boilers have been found to suffer considerably if used with leaky condensers. In spite of their being only fed with distilled water, thick deposits of salt have frequently been found to take place as the result of any defect in the condensers; these deposits especially occur in the upper tubes, which at times become almost completely choked. In order to prevent explosions from taking place from this cause, Belleville places small fusible plugs of lead in the junction boxes, which melt as soon as the tubes become hot through any obstruction of the circulation. The hissing of the steam issuing from the small holes thus made in the boxes warns the stokers of the coming danger; thereupon the fires are drawn and the boiler, after becoming cool, is examined and cleaned. Such occurrences often took place on board the "Hertha" and "Hansa," and it is solely owing to the extraordinary care and vigilance of the engine-room complements of these ships that, beyond the bursting of the Serve tubes already referred to, more serious accidents have hitherto been avoided.

Belleville boilers can be inspected, but only by opening a large number of doors which give rise to leakages and repairs. Complaints, as a consequence, are often heard of the great amount of trouble and labour caused to the *personnel* during the process of inspecting, cleaning, and repairing these boilers. Their peculiarity of producing wet steam

has led to the adoption of a very extensive system of baffle plates, which take up the whole of the steam collector and have to be removed whenever the collector is inspected. These baffle plates suffer considerably by rusting, and have also been quite destroyed by the action of the wet stream of steam impinging on them. A large number of the plates have already, as a consequence, had to be renewed.

Finally, the shortness of the flame circuit between the tubes has proved very inconvenient. The heated gases enter the uptakes and funnels at a very high temperature and heat them excessively. On board H.I.M.S. "Hertha" the funnels gradually collapsed, necessitating lengthy repairs and the adoption of specially arranged stays before they could be made serviceable again.

Taking everything into account, there are no grounds for again bringing this system of boiler into use in the German Navy.

5. *With Yarrow Boilers.*—I have been unable to obtain any details as to the experience with the two Yarrow boilers fitted on board torpedo-boat S 32. It has, however, been proved that they are very uneconomical, and as early as 1898, that is to say, after they had only been two years in commission, 145 tubes had to be replaced in each boiler, which necessitated the boilers being taken out of the boat, as otherwise the water chambers were inaccessible. Any further employment of this system of boilers for torpedo-boats is considered as inadmissible.

VII.—Economy of the Various Systems.

It is very difficult to decide on the exact economy of any boiler system. If, in order to ascertain it, experiments are carried out on shore with any individual type its efficiency will be better or worse, entirely according to the skill of the stokers. For instance, recently during some experiments carried out on shore with a Belleville test boiler fired by an ordinary well-trained stoker, such as is generally available, 1 lb. of coal converted 7·84 lbs. of water at 0° C. into steam at 100° C. whereas with a specially skilful stoker, supplied by the makers of the boiler, the quantity of water evaporated was 8·836 lbs.; in both cases 35·8 lbs. of the same coal were burnt per square foot of grate surface per hour, but in the second experiment the dampers were used at each firing up, and the furnace doors were never kept open longer than ten seconds. It is clear that similar results could never be attained on board ship where a large number of boilers would be simultaneously at work.

Supposing the amount of coal burnt on board ship were to be measured and compared with the I.H.P. developed by the engines, during the period of trial the result would be appreciably influenced by the economy of the engines, by possible leakages from joints and stuffing

boxes, and by the not easily ascertainable consumption of the auxiliary engines, especially of the steam steering engines.

Reliable results could only be obtained by measurements of the feed-water; such measurements, however, are very difficult to carry out, because serviceable water meters are not inserted in the feed pipes, and such experiments could therefore seldom be made.

The results obtained on trial runs, apart from those for ascertaining the economy of the boiler, would, to a certain extent, be free from objections if the work done by the boilers was in all cases the same. This, as will be seen from the tabulated results given in Appendix I., is, however, never the case.

Even for sister ships which are both fitted with the same types of boiler ordered from different makers, the details of construction which have an effect upon the economy, differ considerably, so that sometimes the difference in the calorific results between two boiler installations of one and the same system are greater than the difference between installations of quite different systems. A striking instance of this is to be seen in the two Dürr installations on board the "Baden" and "Bayern."

The coal consumption during the trials of H.I.M. gun-boat "Tiger" must be left out of consideration, because the slide valve packing rings used during these trials have from the experience of the gun-boat "Luchs," built at the same yard, been proved to let steam pass. Besides, when the mean values obtained from the various trial runs with the different systems of boilers are compared, it is found that the difference in the coal consumption per I.H.P. per hour, amounts to about 13 per cent. for ordinary speed and 19 per cent. for continuous full speed.

The following table gives the coal consumption per I.H.P. per hour for the work done by the boiler as stated :—

At Ordinary Speed.

Type of boiler.	Coal consumption in lbs. per square foot of grate surface per hour.	Coal consumption in lbs. per H.P. per hour.
Schulz	16·7	1·96
Niclausse	12·4	1·96
Cylindrical	11·5	2·01
Belleville	8·12	2·01
Dürr	14·0	2·06
Thornycroft...	17·5	2·21
Locomotive	14·9	2·23

At Maximum Continuous Speed.

Type of boiler.	Coal consumption in lbs. per square foot of grate surface per hour.	Coal consumption in lbs. per H.P. per hour.
Thornycroft...	23·6	1·79
Niclausse	15·4	1·81
Cylindrical and Schulz	14·0 and 20·7	1·82
Cylindrical and Thornycroft	14·1 and 21·9	1·84
Cylindrical	17·4	1·86
Dürr	19·7	1·91
Locomotive	28·2	1·98
Belleville	17·1	2·01
Schulz	26·9	2·18

Apart from the fact that these two tables show discrepancies in the order of sequence, *e.g.*, the Schulz boilers in the trial runs at ordinary speed, occupy the first place whilst they take nearly the last place in the maximum continuous speed runs; it will be seen on reference to the tables in Appendix I. that some of the boiler systems have both very low and very high coal consumptions, hence the statement seems justified that the boilers of all these systems, if properly proportioned and properly handled, pretty well all work with the same economy.

This seems to be the case as regards the cylindrical, Schulz, Thornycroft, and Dürr boilers, with which the following very favourable coal consumptions have in certain instances been obtained:—

Type of boiler.	On board H.I.M.S.	Lbs. per I.H.P. per hour.
Cylindrical	Wörth	1·58
Schulz	Nymphe	1·67
Thornycroft...	Iltis	1·60
Dürr	Bayern	1·56

As a rule the results of trial runs available are too few for deductions to be drawn from them as to which type of boiler is the best on the score of economy, for it is impossible from two such entirely different results as were given in the ordinary speed trials of the "Württemberg" and "Nymphe"—which vary some 35 per cent. from each other—to take the arithmetical mean, and to use the figure so obtained as a basis from which to judge the economy of the system. It may be taken for granted, however, that the results of the trials so far carried out go to show that equally good results can be obtained from the Schulz and Dürr boilers as from cylindrical boilers.

It was at first freely asserted that water-tube boilers under continuous steaming would be less economical than cylindrical boilers. But this assertion is not borne out by the coal consumed by the First Squadron during a trip to Lisbon in the summer of 1899. In the following table the coal consumption of the ships forming this squadron is given, first for their official acceptance trials, and secondly for the voyage referred to at 9 and 12·5 knots speeds :—

Name of Ship.	Official acceptance trials. lbs. of coal per hour		Voyage to Lisbon. At 9 knots. lbs. of coal per hour		At 12·5 knots. lbs. of coal per hour	
	per square foot of grate	per H.P.	per square foot of grate	per H.P.	per square foot of grate	per H.P.
1.—Cylindrical Boilers.						
Brandenburg	12·0	1·64	10·9	2·8	16·64	2·205
Weissenburg	12·3	1·74	11	3·13	16·67	2·266
Kurfürst Friedrich Wilhelm	12·9	1·83	9·7	2·8	15·28	2·39
Wörth	9·7	1·58	10·3	3·24	14·44	2·081
Mean	*11·7*	*1·70*	*10·46*	*2·998*	*15·76*	*2·237*
2.—Dürr Boilers.						
Baden	15	2·32	18·2	4·056	20·48	2·908
Bayern	14	1·97	15·87	3·064	22·32	2·359
Mean	*14·5*	*2·14*	*17*	*3·56*	*21·4*	*2·632*
3.—Thornycroft Boilers.						
Ægir	10·4	2·15	18·2	3·263	25	2·685

The coal consumption per I.H.P. has, consequently, increased on the average as follows :—

Type of Boiler.	At 9 knots.	At 12·5 knots.
Cylindrical	About 78·7 per cent.	About 33·4 per cent.
Dürr	„ 67·5 „	„ 24·4 „
Thornycroft	„ 53·6 „	„ 26·3 „

That is to say, the depreciation in economy, as compared with the official acceptance trials, has been greater with the cylindrical boilers than with the water-tube boilers. If the mean values are considered, the coal consumption per I.H.P. is actually greater with water-tube boilers than with cylindrical boilers, because only two sets of Dürr boilers are used in the comparison, one of which—in the "Baden," which were the first of the system to be used on board a war-ship—from the outset proved themselves to be uneconomical, and because among the small-tube water-tube boilers only one Thornycroft boiler comes into the comparison.

The coal consumption per I.H.P. of the "Bayern," on the other hand, for continuous steaming is approximately the same as in the ships with cylindrical boilers, viz., 3·064 lbs., as against the mean for the four ships of 2·998 lbs. at 9 knots, and 2·359 lbs., as against the mean for the four ships of 2·237 lbs. at 12½ knots. The coal consumption of the Schulz boilers in H.I.M.S. "Nymphe" was, so long as the coal lasted, on a full-speed continuous run, as low as 2·171 lbs. per I.H.P.

From these figures it will be seen that the reproach of being uneconomical cannot be indiscriminately applied to all water-tube boilers.

VIII.—Efficiency of the Various Systems.

1. *Calculated on the Basis of Floor Space.*—The efficiency of the boilers referred to in this article, calculated on the amount of floor space taken up by them, depends upon the extent of forcing permissible, the grate area which can be fitted with a given boiler-room floor space being almost similar in all the systems. In the ships already fitted with water-tube boilers in the German Navy, the amount of grate surface per square foot of boiler-room floor space is as follows:—

Type of Boiler.	Square feet of grate area.
Schulz...	0·177 to 0·267
Dürr	0·18 „ 0·278
Cylindrical	0·218 „ 0·264
Thornycroft	0·18 „ 0·247
Locomotive	0·118 „ 0·13

If the space available is restricted, a somewhat larger amount of grate surface can be placed within a given floor space by using Dürr boilers than would be possible if small-tube water-tube boilers with adequate sized water chambers were selected.

As with cylindrical boilers, the pressure used in the ashpit is less than half an inch (·47 inch), which admits of burning not more than about 24·58 lbs. of coal per square foot of grate surface per hour, whilst with the Dürr and Schulz boilers about 37 lbs. can be quite conveniently burnt, the efficiency of the cylindrical boilers as compared with the water-tube boilers in question, taking the amount of floor space available in the boiler-room, stands about as 2 : 3.

2. *Calculated on the Weight.*—As regards the weights of boiler installations, these depend considerably upon the amount of forcing the boilers will be subjected to, the smaller the installation is for a given power the less economical will it be for a greater power, because it will then have to be heavily forced, but the installation per I.H.P. will be lighter. A certain limit will be imposed on the makers by

the fixing of the maximum coal consumption for the continuous maximum speed runs; the proportions of the boilers for the maximum power of the engines will, however, vary considerably, as the coal consumption is not ascertainable for runs with the maximum power of the engines when the boilers are being forced, only the H.P. per square foot of grate and of heating surfaces being available for the purposes of comparison. From the tabulated details given in Appendix II. of the results of trials already carried out with the maximum power of the engines, the following appear to be the powers obtainable :—

Type of Boiler.	I.H.P.	
	Per square foot of grate surface.	Per square foot of heating surface.
Cylindrical	9·0 to 13·8	·323 to ·418
Locomotive	16·2 „ 23·7	·313 „ ·532
Dürr	11·8 „ 17·4	·288 „ ·388
Thornycroft	16·2 „ 19·2	·304 „ ·369
Schulz	15·0 „ 17 1	·274 „ ·334

Nevertheless, the mean values ascertained from the comparative results shown in Appendix II. afford a standard for judging the efficiency of the several systems as measured by their weight. According to these mean values the weight of the boiler installations, *i.e.*, the weight of the boilers, with uptakes and funnels, including all the auxiliary engines with their steam and water connections in the boiler-room used for working the boilers, stands to the powers obtained as follows :—

Type of boiler.	I.H.P.		Lbs. per I.H.P.
	Per square foot of grate surface.	Per square foot of heating surface.	
Cylindrical	12·5	·390	161·0
Cylindrical and Schulz ...	13·6	·328	131·0
Cylindrical and Thornycroft ...	13·7	·352	130·0
Dürr	14·6	·347	111·0
Locomotive	20·8	·427	106·8
Belleville...	12·5	·398	103·2
Niclausse...	13·3	·396	91·5
Schulz	16·0	·304	85·5
Thornycroft	17·2	·332	81·2

The figures given in the table of Appendix II. also show approximately how much more weight can be spared by using the various boiler systems, if the work done by the boiler is further increased. For this, however, the statements of the coal consumption shown in the tables of Appendix I. for continuous maximum speed runs with all the boilers at

work must be taken into consideration, because these values have a close connection with the powers obtained from the boilers; whereas, when running at ordinary speed as many boilers can be used as are required to prevent the work done by any single boiler being too great.

It is evident that the values of the weight of each individual boiler installation per I.H.P. is affected by the efficiency of the engines, and also by all the little contingencies met with in the trial runs, and by the greater or lesser skill of the stokers; it would therefore be expedient to obtain a larger amount of *data* from which to draw comparisons in order to obtain more reliable mean values. According to the *data* in regard to weights here collected, the choice of a mixed boiler installation on board battle-ships leads to a saving in weight of $\frac{158{\cdot}7-128{\cdot}6}{158{\cdot}7}$ = about 20 per cent. over an installation of cylindrical boilers only; for this class of ship this represents some 190 tons, which can be utilised either in coals, thereby increasing the radius of action, or in some other way. By the installation of Dürr boilers a further saving of some 19 lbs. per I.H.P. would be effected, which, with 15,000-I.H.P., would mean a further gain of some 120 tons; if Schulz boilers were to be chosen the saving in weight over mixed boilers would be some 44 lbs. per I.H.P., equal to a further reduction of about 270 tons.

IX.—Cost of the Various Systems.

It is difficult to ascertain the cost of the various systems of boilers, because those in the Imperial yards have been constructed at various times, and, consequently, under varying conditions of trade and of the labour market, etc., whilst, on the other hand, the tenders from private yards seldom give any details that can be used for purposes of comparison. Again, the cost per I.H.P. is greatly influenced by the amount of forcing the boilers can be subjected to, and also by the efficiency of the engine installation.

In order to be able to form a rough estimate, a few figures are given as to the cost of some installations. The Schulz boiler installation for H.I.M.S. "Württemberg" cost £26,613 15s. These boilers are very lightly worked; if *they were to be forced approximately to the same extent as* in the case of H.I.M.S. "Nymphe" on the occasion of her six hours' acceptance trial under forced draught, *i.e.*, to a development of 17·58 I.H.P. per square foot of grate area, and ·315-I.H.P. per square foot of heating surface—the steam generated would be sufficient to develop 7,100-I.H.P., making the cost of the boiler installation about £3 15s. per I.H.P.; this figure is approximately the same as the estimate of the Schiff- und Maschinenbau - Aktien - Gesellschaft Germania for a Schulz boiler installation.

PRINCIPAL DATA OF BOILERS FOR THE GERMAN NAVY.

APPENDIX I.

Results with Triple-Expansion Engines.

Ship.	Contractors' acceptance trials.				Under ordinary working conditions.			
	Continuous maximum speed run.		Ordinary speed.		Continuous maximum speed run.		Ordinary speed.	
	lbs. of coal per sq. foot of grate.	lbs. of coal per I.H.P.	lbs. of coal per sq. foot of grate.	lbs. of coal per I.H.P.	lbs. of coal per sq. foot of grate.	lbs. of coal per I.H.P.	lbs. of coal per sq. foot of grate.	lbs. of coal per I.H.P.
I.—*Cylindrical Boilers.*								
Brandenburg	20·2	1·76	12·0	1·64	19·3	1·82	16·6	2·33
Kurfürst Friedrich Wilhelm	18·5	1·74	12·9	1·83	17·2	1·89	15·2	2·42
Weissenburg	18·6	1·66	12·3	1·74	19·0	1·85	16·6	2·29
Wörth	19·2	1·73	9·7	1·58	17·0	2·11	14·4	2·10
Kaiserin Augusta	14·7	1·88	12·0	1·99	20·6	1·94	11·8	1·84
Gefion	16·0	1·73	10·7	2·22	23·1	2·08	—	—
Cormoran	20·5	1·96	16·1	2·62	17·0	2·7	—	—
Condor	18·3	2·07	10·2	1·69	16·9	2·85	—	—
Geier	15·5	1·79	13·4	2·2	14·6	2·7	—	—
Pelican	14·2	1·81	4·65	1·87	—	—	—	—
Buzzard	20·7	2·29	12·8	2·72	—	—	16·5	3·22
Hohenzollern	12·5	1·95	—	—	16·8	2·04	—	—
**Mean*	*17·4*	*1·86*	*11·5*	*2·01*	*18·2*	*2·2*	—	—
II.—*Locomotive Boilers.*								
Siegfried	18·1	1·97	6·7	1·87	29·7	3·17	—	—
Beowulf	23·9	1·77	15·9	1·87	—	—	—	—
Frithjof	29·2	1·99	17·6	2·18	—	—	—	—
Hildebrand	35·3	2·15	19·0	2·57	—	—	—	—
Heimdall	30·2	1·92	18·1	2·27	—	—	—	—
Hagen	31·4	1·87	—	—	—	—	—	—
Odin	24·9	1·94	9·05	2·4	—	—	—	—
Hela	28·8	1·89	17·3	2·19	—	—	—	—
Wacht	28·6	1·82	—	—	—	—	—	—
Jagd	40·0	2·29	—	—	26·5	1·81	—	—
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
Bayern	18·0	2·0	15·0	2·82	22·1	2·62	20·4	2·94
Sachsen	17·2	1·56	14·0	1·97	26·6	2·28	20·6	2·39
Victoria Luise	23·06	2·06	—	—	23·3	1·98	—	—
Vineta	19·2	1·99	13·9	1·86	—	—	—	—
**Mean*	*19·7*	*1·91*	13·2	2·08	—	—	—	—
			14·0	*2·06*	*24·1*	2·06	—	—

APPENDIX II.

Particulars of the several boiler installations.

(The boiler-room weights include boilers, pipes, auxiliary engines, funnels, etc.)

Ship.	Maximum continuous I.H.P. developed.	Total weight of boiler. Tons.	Grate surface, sq. feet.	Heating surface sq. feet.	I.H.P. per sq. foot of grate surface.	I.H.P. per sq. foot of heating surface.	Total weight in lbs. per I.H.P.
I.—*Cylindrical Boilers.*							
Brandenburg	9,863	728	753	24,640	13·1	·400	165·6
Kurfürst Friedrich Wilhelm	9,850	732	753	24,640	13·0	·398	166·7
Weissenburg	9,964	717	753	24,640	13·2	·402	161·5
Wörth	10,330	693	753	24,640	13·7	·418	150·0
Gefion	14,310	905	1,033	35,700	13·8	·400	141·5
Cormoran	9,116	598	715	22,700	12·7	·402	147·0
Condor	2,816	203	224	7,534	12·5	·374	162·1
Geier	2,840	193	226	7,050	12·5	·402	152·0
Pelican	2,920	209	226	7,050	12·9	·415	161·0
Buzzard	3,028	219	258	8,400	1·7	·361	161·8
Hohenzollern	2,770	213	226	7,150	12·2	·384	173·0
**Mean*	9,325	778	1,033	28,800	9·0	·323	187·5
	—	—	—	—	*12·5*	*·390*	*161·0*
II.—*Locomotive Boilers.*							
Siegfried	4,725	200	232	10,763	20·4	·438	95·2
Beowulf	4,810	222	219	11,850	22·0	·406	103·8
Frithjof	4,900	221	219	11,850	22·3	·412	101·2
Hildebrand	5,260	220	222	9,850	23·7	·532	93·8
Heimdall	4,336	231	213	10,610	20·2	·408	120·0
Hagen	4,452	240	213	10,610	20·9	·42	120·8
Odin	3,481	243	215	10,615	16·2	·328	156·0
Hela	5,925	237	281	12,500	21·1	·472	89·8
Wacht	—	—	—	—	—	—	—
Jagd	3,430	169	162	11,000	21·0	·313	110·9
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Bayern	6,118	347	517	16,750	11·8	·366	127·0
Sachsen	6,280	348	454	21,800	13·8	·288	123·5
Victoria Luise	6,370	323	437	18,250	14·5	·348	113·6
Vineta	10,420	408	674	29,850	15·4	·346	88·0
**Mean*	10,500	472	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Wacht	28·6	1·82	—	—	26·5	1·81	—	—	3,430	169	162	11,000	21·0	·213	—	110·9
Jagd	40·0	2·29	—	—												
	28·4	1·92	13·7	2·26												

III.—*Dürr Boilers.*

	13·0	2·0	15·6	2·32	22·4	2·62	20·4	2·94	6,118	347	517	16,750	11·8	·366	127·0
Bayern	17·2	1·56	14·0	1·97	26·6	2·28	20·6	2·39	6,280	348	454	21,800	13·8	·288	125·5
Sachsen	23·06	2·06	—	—	23·3	1·98	—	—	6,370	323	437	18,250	14·5	·318	113·6
Victoria Luise	19·2	1·99	13·9	1·86	—	—	—	—	10,420	408	674	29,850	15·4	·346	88·2
Vineta	—	—	13·2	2·08	—	—	—	—	10,500	472	600	27,000	17·4	·388	101·0
*Mean...	*19·7*	*1·91*	*14·0*	*2·06*	*24·1*	*2·29*	—	—	—	—	—	—	*14·6*	*·347*	*111·0*

IV.—*Thornycroft Boilers.*

Ægir	22·4	1·69	10·4	2·15	24·5	1·94	23·9	3·32	4,909	192	274	16,150	17·9	·304	87·6
Three Days' run ...	—	—	—	—	28·6	2·08	25·0	2·72	—	—	—	—	—	—	—
Iltis	24·9	1·60	21·8	1·99	—	—	—	—	1,358	466	818	4,098	16·6	·331	77·0
Jaguar	24·9	1·69	19·7	1·84	—	—	—	—	1,358	471	818	4,098	16·6	·331	77·7
Tiger	39·1	2·79	21·6	3·31	—	—	—	—	1,351	541	818	4,098	16·5	·331	90·0
Luchs	28·6	2·12	16·4	2·9	—	—	—	—	1,325	542	818	4,098	16·2	·324	91·6
Niobe	17·4	1·89	19·0	2·16	—	—	—	—	8,000	226	416	2,176	19·2	·369	63·2
*Mean...	*23·6*	*1·79*	*17·5*	*2·21*	—	—	—	—	—	—	—	—	*17·2*	*·332*	*81·2*

V.—*Schulz Boilers.*

Württemberg	26·9	2·29	21·6	2·23	26·6	2·51	—	—	6,177	292	412	22,500	15·0	·274	106·0
Nymphe	—	—	11·8	1·67	—	—	—	—	8,375	243	488	25,000	17·1	·334	65·3
Three Days' run ...	26·6	2·10	—	—	—	—	—	—	—	—	—	—	—	—	—
*Mean	*26·7*	*2·18*	*16·7*	1·96	—	—	—	—	—	—	—	—	*16·0*	*·304*	*85·5*

VI.—*Niclausse Boilers.*

Gazelle	15·4	1·81	12·4	1·93	—	—	—	—	6,275	252	462	15,650	13·6	·402	90·0
Freya	—	—	—	—	—	—	—	—	10,100	417	775	25,850	13·0	·390	92·7
*Mean...	—	—	—	—	—	—	—	—	—	—	—	—	*13·3*	*·396*	91·5

VII.—*Belleville Boilers.*

Hertha	17·5	2·03	7·65	2·17	19·2	2·18	13·5	3·94	10,050	449	795	24,000	12·6	·400	100·5
Hansa	16·6	1·99	8·6	1·85	—	—	—	—	9,928	472	795	24,000	12·4	·395	106·8
*Mean...	*17·1*	*2·01*	*8·12*	*2·01*	—	—	—	—	—	—	—	—	12·5	*·398*	103·2

VIII.—*Mixed System.—Cylindrical—Thornycroft.*

Kaiser Friedrich III. ...	14·1/21·9	1·84	—	—	18·1/35·4	2·54	—	—	12,860	593 154	655 280	23,280 13,250	13·7	·352	130·0

IX.—*Mixed System.—Cylindrical—Schulz.*

Kaiser Wilhelm II. ...	14·0/20·7	1·82	—	—	—	—	—	—	—	—	—	—	—	—	—
Fürst Bismarck ...	—	—	—	—	—	—	—	—	13,420	785	655 327	23,400 17,450	13·6	·328	131·0

The cylindrical boilers in the mixed installation on board H.I.M.S. "Kaiser Friedrich III." on the six hours' official trial when the engines developed 13,000-I.H.P., are credited with a development of about 13-I.H.P. per square foot of grate surface; if, however, an air pressure of only ·47 inch is used and the consequent development attained is not more than 11·61-I.H.P. per square foot of grate area, and ·325-I.H.P. per square foot of heating surface, then the power developed by the cylindrical boilers would be only 7,600-I.H.P. As this part of the installation cost £32,950, the cost per I.H.P. on this assumption would be about £4 6s. 8d.

An installation of Dürr boilers, if the arithmetical mean is assumed as being correct, would, according to the last tenders submitted by private firms, cost about £3 10s. per I.H.P. By taking other *data* for working out the calculations, the difference in price, however, comes out extremely small, the Dürr boilers in certain cases even coming out somewhat dearer than cylindrical and Schulz boilers. According to a report from the Imperial Yard at Kiel, the following prices have been paid for the boilers, with casing plates and lagging, of the ships built at the yard during the last few years, viz.:—For cylindrical boilers, £1 15s. 4d.; for Dürr boilers, £1 11s. 6d. to £2 0s. 11d.; for Schulz boilers, £1 15s. 7d. to £1 16s. 10d., calculated on the I.H.P. contracted for.

X.—Concluding Remarks.

From the foregoing it will be seen that the decision of the German Navy to construct Schulz and Dürr boilers whilst carrying out experiments with other systems has been attended with satisfactory results. We may well be contented with the success hitherto attained, and the time may, perhaps, not be far distant when the other naval Powers will follow in our footsteps. We began to build water-tube boilers somewhat later than other countries, but it is now recognised abroad that we have consistently progressed, and have now come to the front of other nations, who begin to see that their selection from the various systems has been so unlucky that they have now to search for a better type of water-tube boiler.

It is not improbable that further experience may lead to the adoption altogether of water-tube boilers, and that one type may prove better than the other. For the present, however, the principle has been adopted to fit gun-boats and small cruisers, where saving of weight is of special consequence, with Schulz boilers; large cruisers with Dürr boilers; and battle-ships, which can stand heavy boiler installations somewhat better, with cylindrical and Schulz boilers.

Fig. 1.

Cylindrical Boiler.

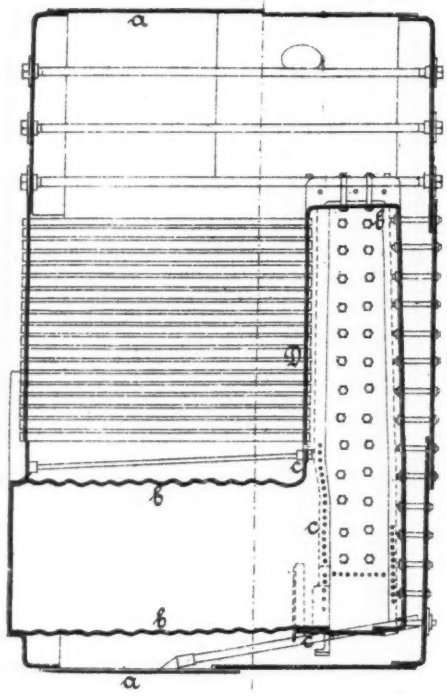


Fig. 2.

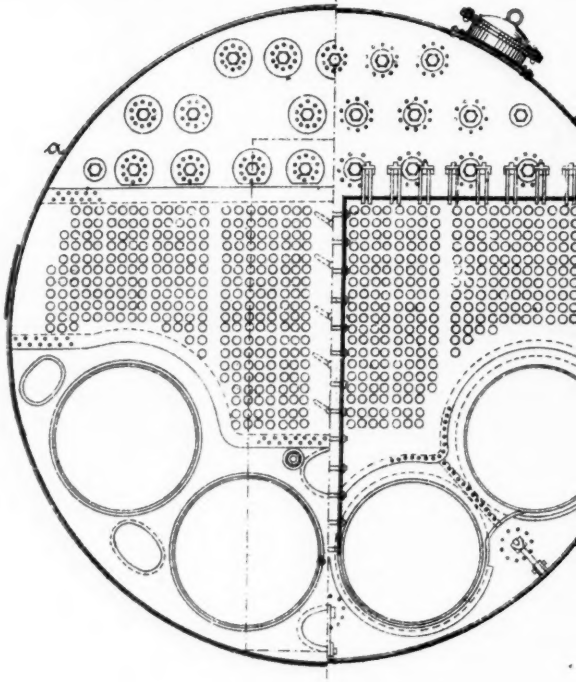
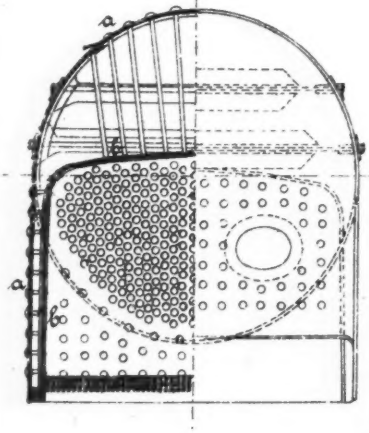
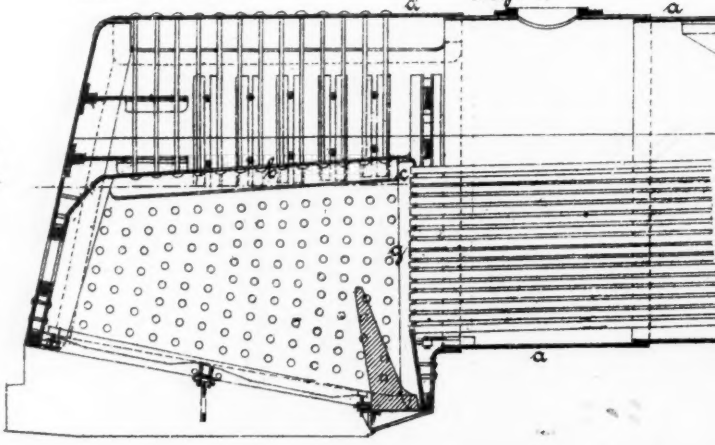


Fig. 3.



Locomotive Boiler.

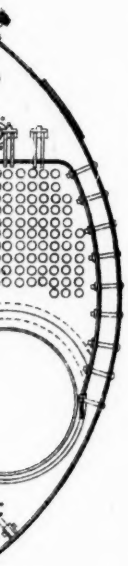
Fig. 4.



J. J. Keliher & Co. Ltd. Litho London

Lagrafel-D'Allest Boiler.

Fig. 5.



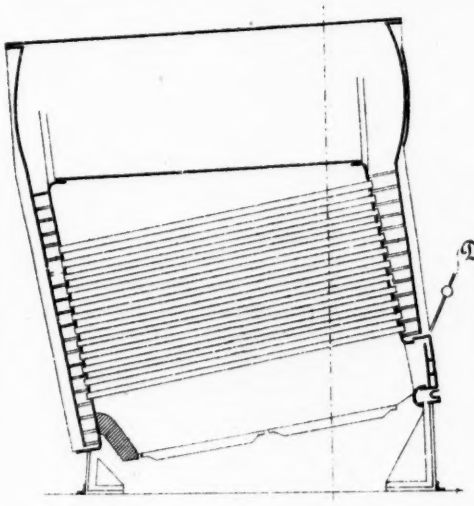
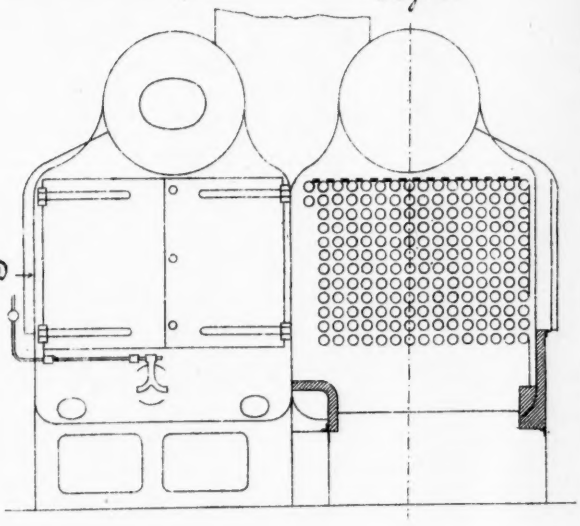
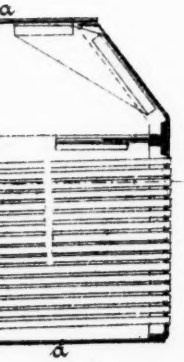


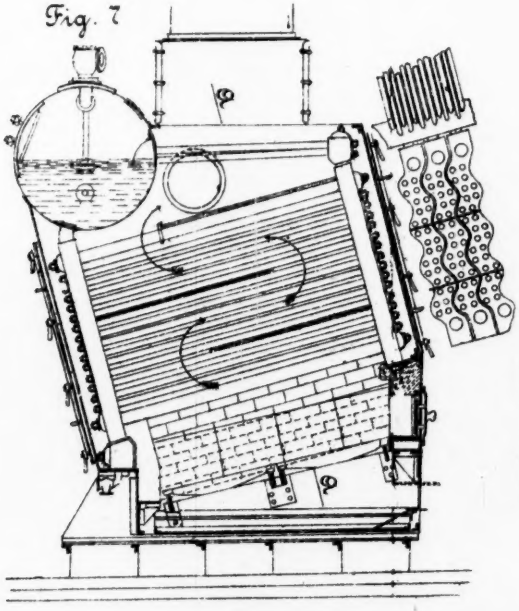
Fig. 6.



Babcock & Wilcox Boiler.

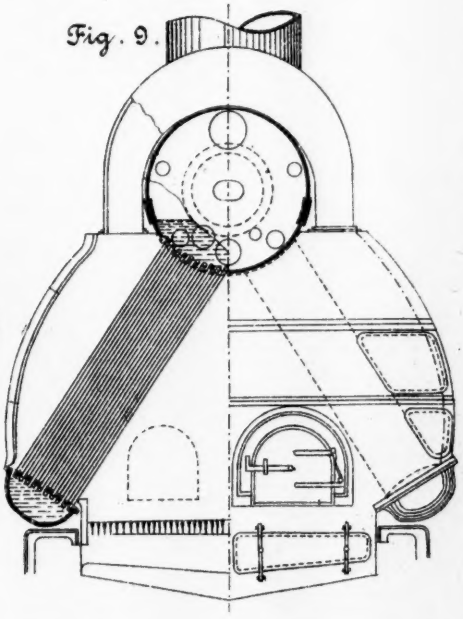
Fig. 7





Yarrow Boiler.

Fig. 9.



Lagrafel-D'Allest Boiler.

Fig. 6.

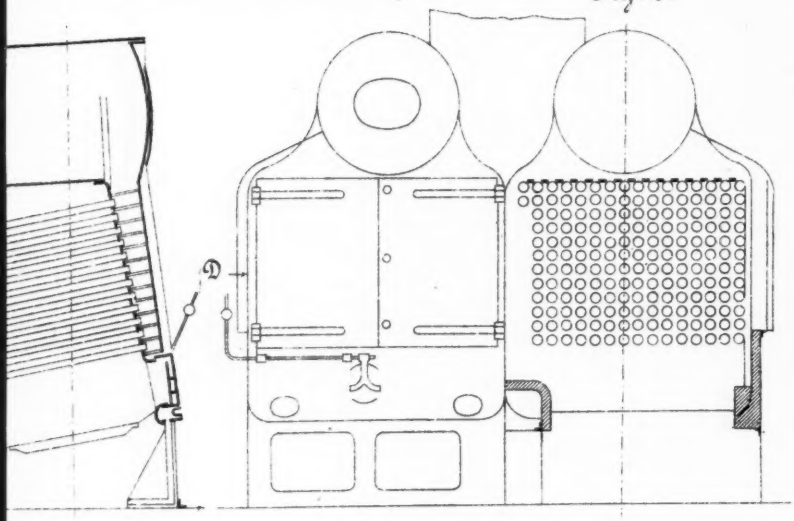
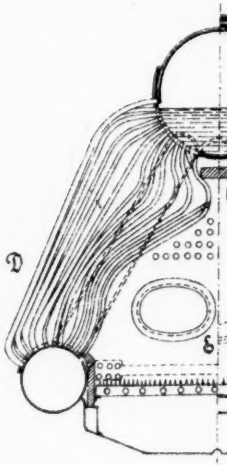
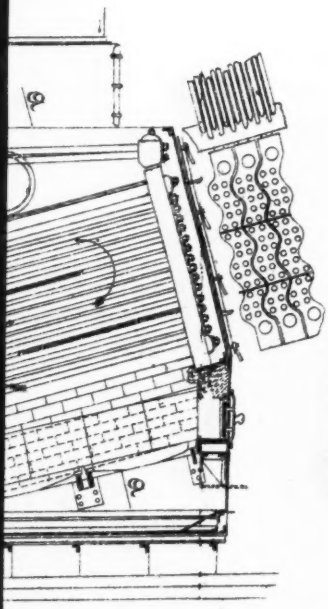


Fig. 12.

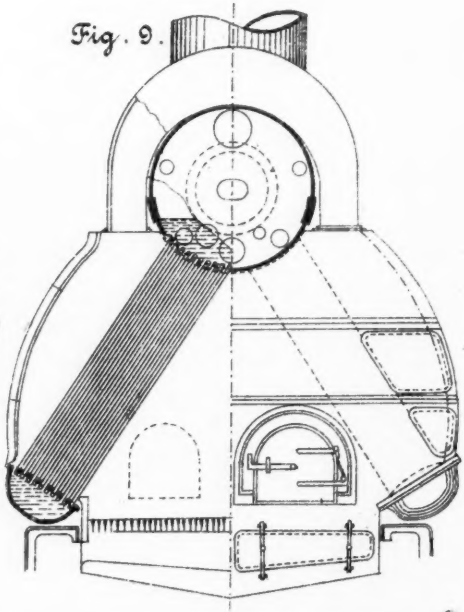


Wilcox Boiler.



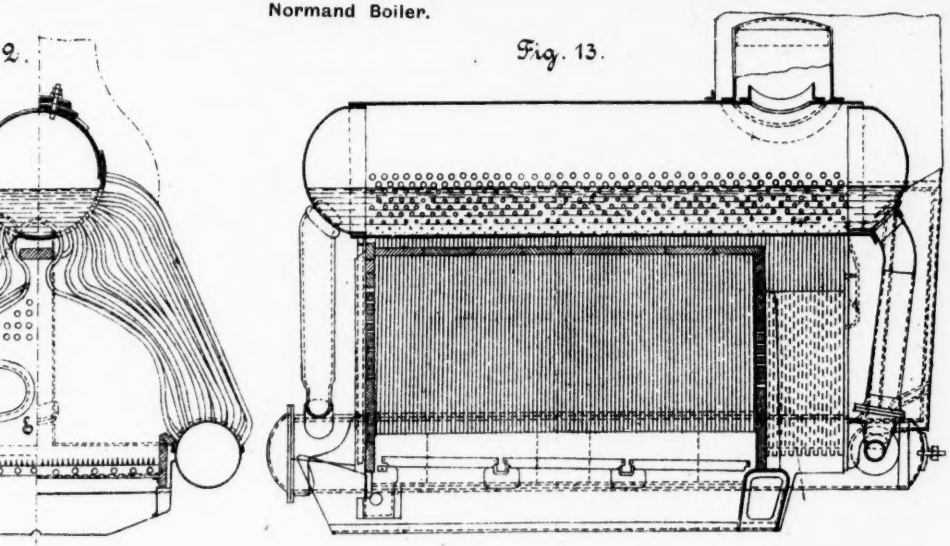
Yarrow Boiler.

Fig. 9.



Normand Boiler.

Fig. 13.



Thornycroft Boiler ("Speedy" Type)

Fig. 14.

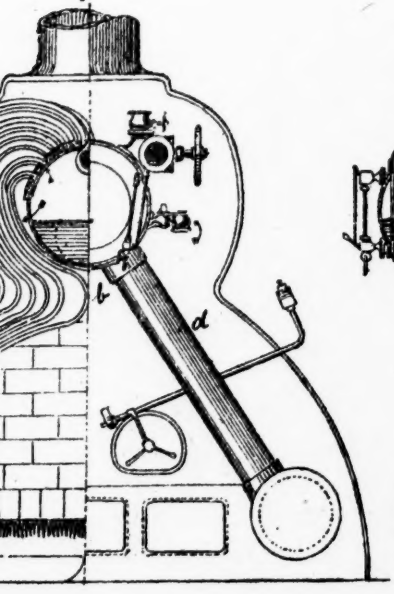
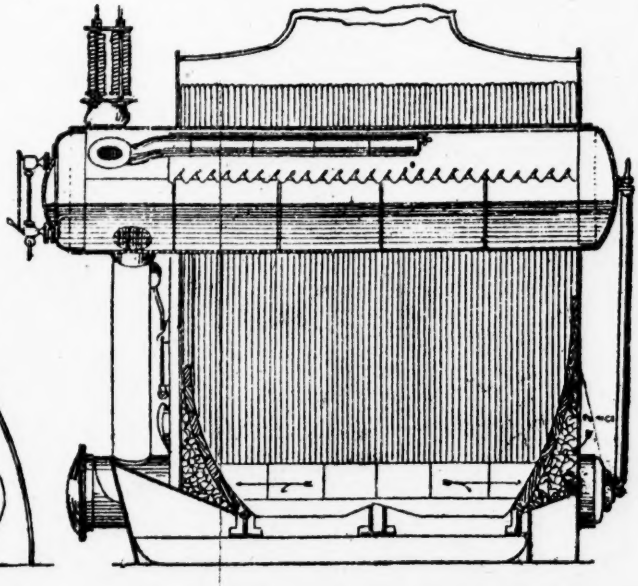


Fig. 15.



Thornycroft Boiler ("Daring" Type)

Fig. 16.

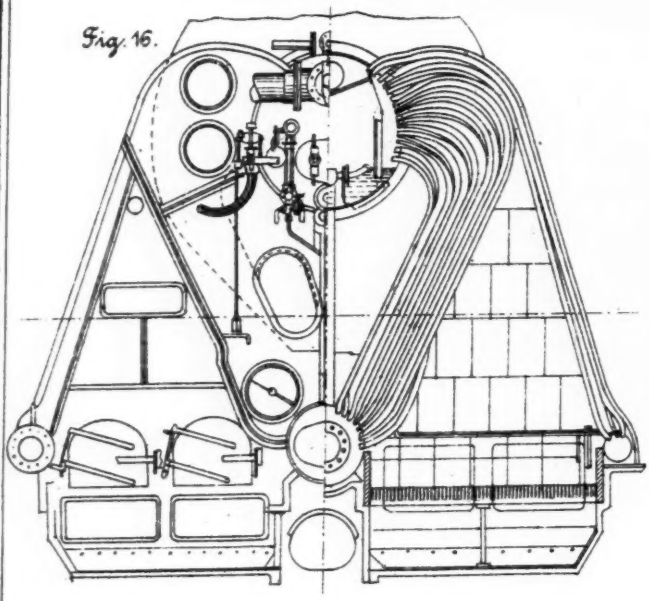
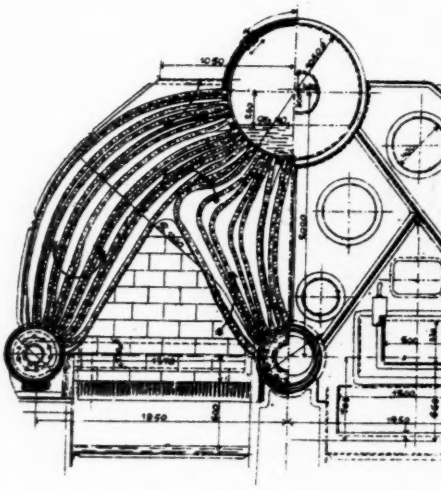


Fig. 17.



Stoppers at Back-

Belleville Boiler.

Fig. 23.

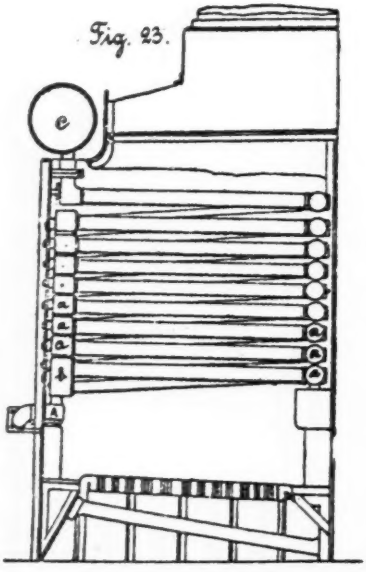


Fig. 24.

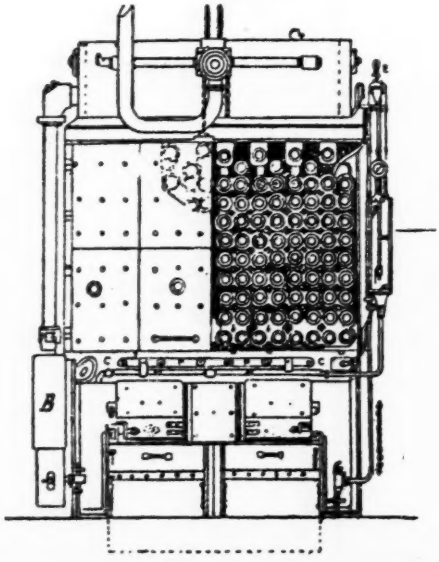


Fig. 28.

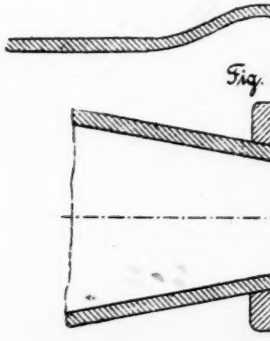


Fig.

J. J. KELLNER & Co. LTD LITHO LONDON

Schulz Boiler.

Niclausse

Fig. 18.

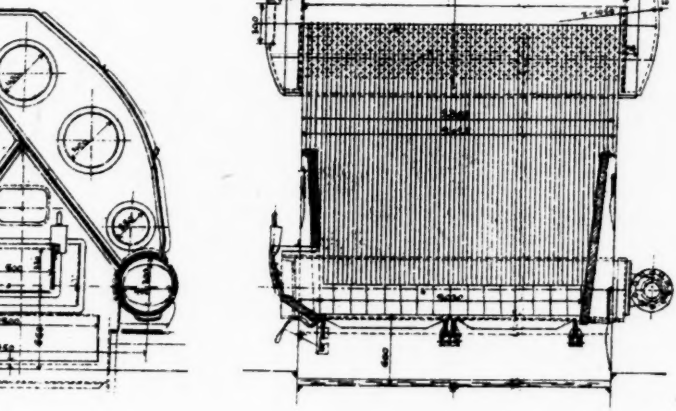
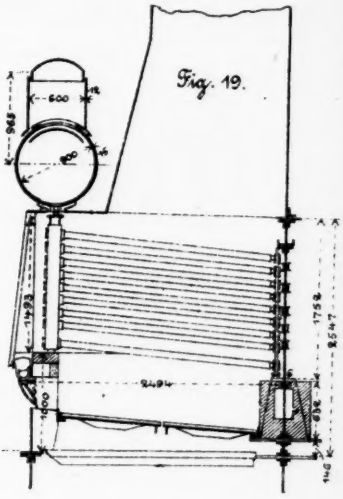


Fig. 19.



Guiding Rollers for Steel Wire Brushes and Scrapers.

Back-end of Tubes of Dürr Boiler.

Old Form of Construction.

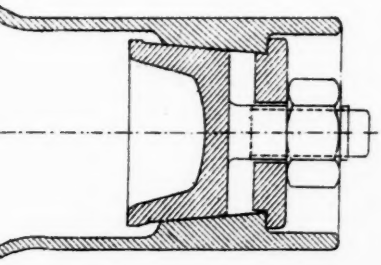


Fig. 28. New Form of Construction.

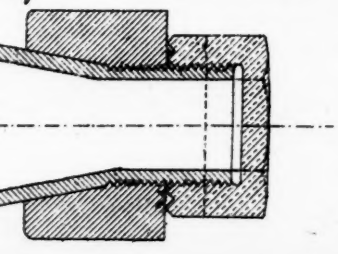
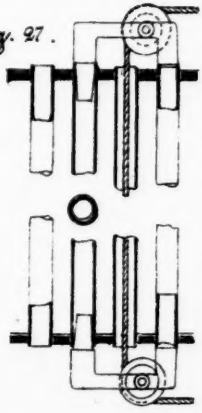
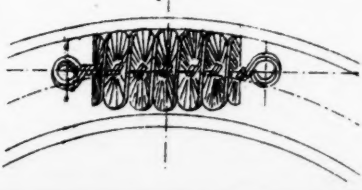


Fig. 27.



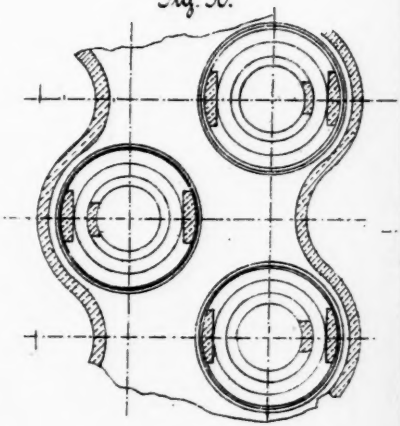
Steel Wire Brushes.

Fig. 25.



Water C

Fig. 30.



Niclausse Large Tube Boiler.

Fig. 19.

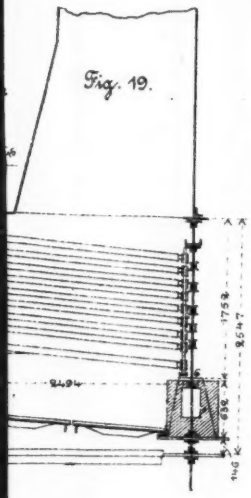
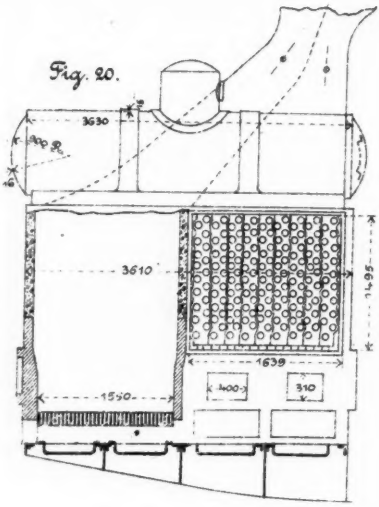


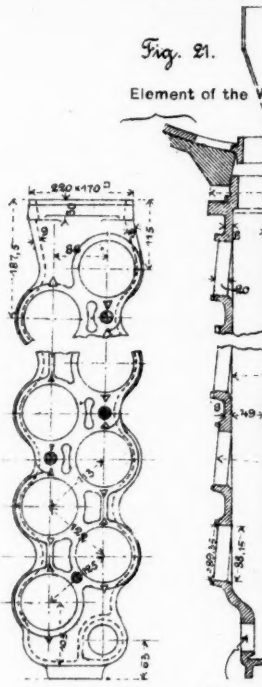
Fig. 20.



Header of

Fig. 21.

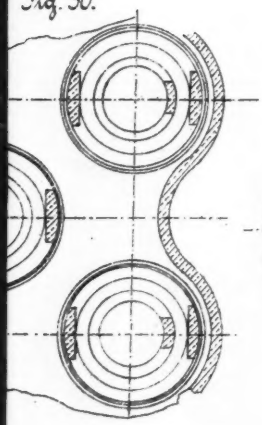
Element of the W



Water Chamber or "Header" of the Niclausse Boiler.

(Fig. 30-33.)

Fig. 30.



Old Form of Lanterne.

Fig. 31.

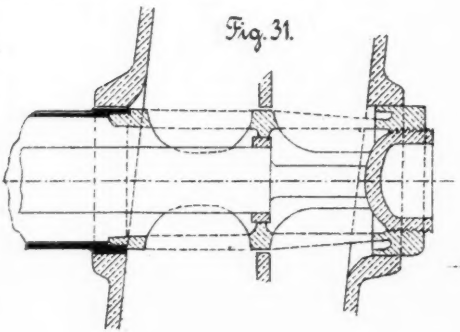
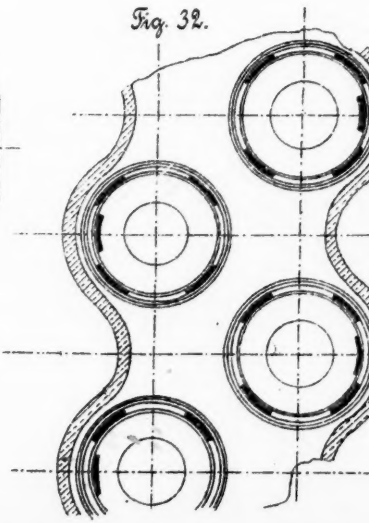


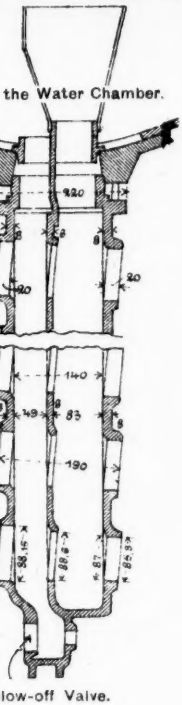
Fig. 32.



Spring Tube Scrapers.

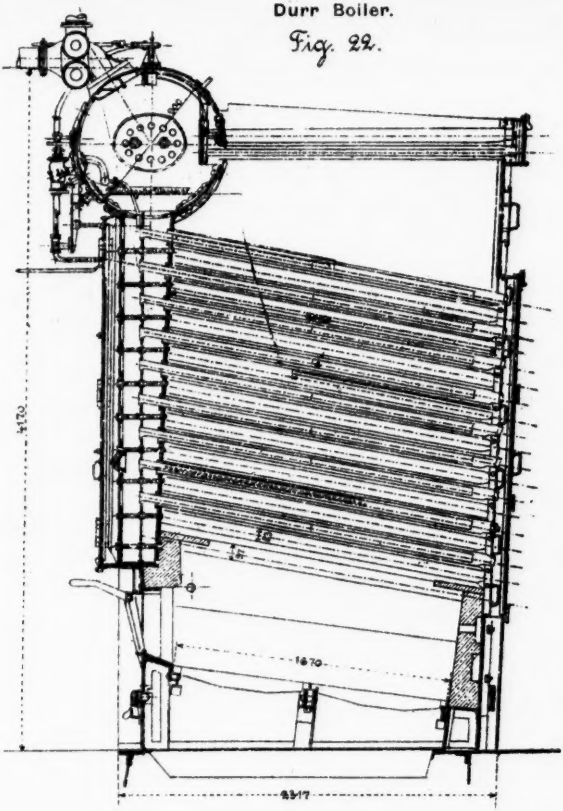
Fig. 26.

r of Niclausse Boiler.



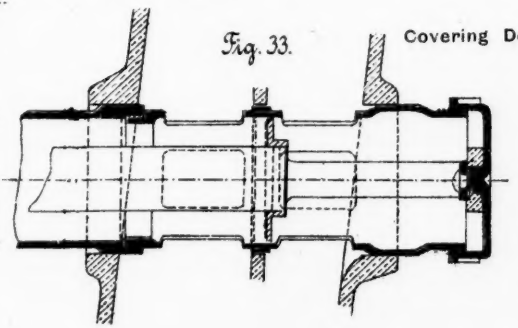
Durr Boiler.

Fig. 22.



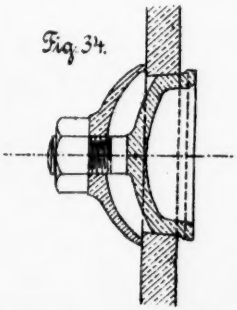
New Form of Lanterne.

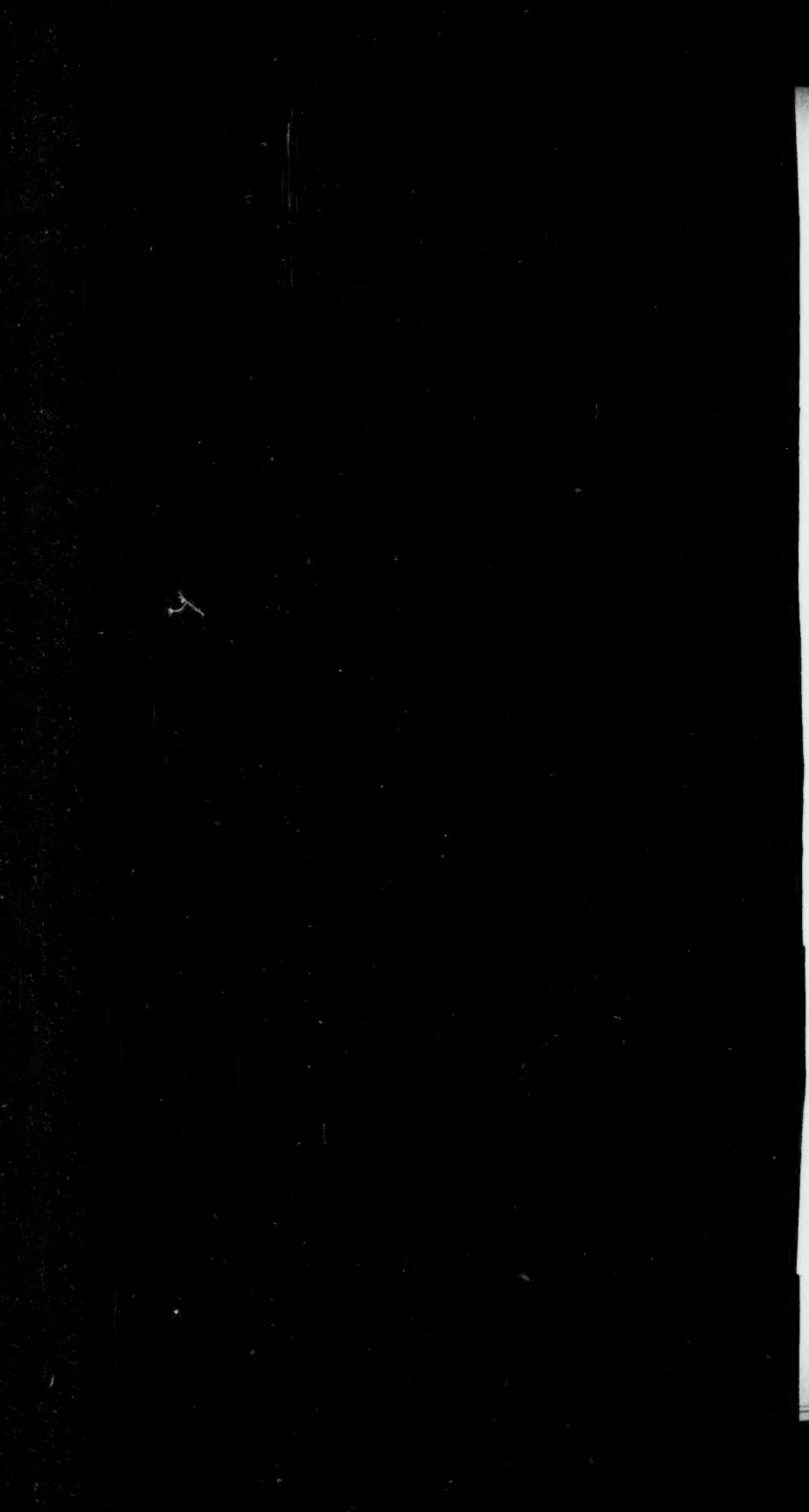
Fig. 33.



Covering Doors of front of Dürr Boiler.

Fig. 34.





THE NETHERLANDS SOUTH AFRICAN RAILWAY COMPANY AND THE TRANSVAAL WAR.

An account by the Secretary, TH. STEINMETZ, dated April, 1900.

Translated from the "Indisch Militair Tijdschrift," No. 4, of 1901, in which it was reprinted from "De Ingenieur," 14th and 21st July, 1900.

I.—Before the War.

THE war, which eventually broke out on 11th October, 1899, was preceded by a long period of tension, of alternate hope and fear.

The consequences to the Z.A.S.M. were a decrease in the inward goods traffic and an increase in the outward passenger traffic.

As early as August, and even some months before, many people looked upon a speedy commencement of the contest as unavoidable, and began to send their families to Cape Colony and Natal and to Europe.

The position of affairs became more and more acute; many people began to lose part of their income; Johannesburg became quieter; the excited tone of the English newspapers, in which the Boers were pictured as barbarians, who would, in case of war, destroy everything, and would not spare even women and children, made the foreign population more and more anxious, and more inclined to leave the country.

Naturally, it was principally the English subjects who fled. Many of them were poor; and for this reason the Cape Railway lowered its fares for destitute fugitives, and proposed to the Z.A.S.M. to do the like.

The latter railway refused, however, to do so, on the ground that there was no reason at the time to assume that Johannesburg was more unsafe than any other place in South Africa. In September the exodus began to be serious, and was at its highest point when, after the declaration of war, all English subjects, who could not get permission to remain, had to leave the country within a week.

British subjects of colour—the so-called coolies from the English East Indies and the Cape bastards—were also obliged to leave.

The cessation of work in the mines made it most necessary to put over the frontier as soon as possible the many thousand Kaffirs who were,

in consequence of it, without work and without bread, and easily turned their attention to plundering and robbery.

The figures below show how many whites and persons of colour were carried to the frontier in the month of September, and in October up to the 19th.

Date.	1st Class.	2nd Class.	Coloured Class.[1]	Total.
September	3,399	10,347	19,775	33,521
October 1-19	2,472	16,433	78,565	97,470
——	5,871	26,780	98,340	130,991

Of the total 130,991 about 53,000 (*sic*) were white and 78,000 coloured. In ordinary times about 9,000 persons leave the country per month. Taking into account that this exceptional passenger traffic partly coincided with the mobilisation and the conveyance of burghers to the frontier, it is not surprising that the number of carriages was wholly inadequate and that people had to be put into open cattle and goods trucks.

As far as possible endeavours were made to put the white women in carriages, and the other whites in separate trucks. Yet one frequently saw trucks packed tight with men of every conceivable colour, from the purest white to the deepest black.

As the journey to Cape Town took at least two days, to Durban one and a half, and to Lourenço Marques one, anyone who knows the African climate can imagine the sufferings endured from heat, cold, and rain, and, in addition, from hunger and thirst.

That there were no accidents on the Z.A.S.M. lines was a great piece of luck, and speaks well for the conduct of its *personnel*.

In order to follow the course of events further it is necessary to go more closely into the relations of the Z.A.S.M. to the Government of the Z.A.R. in time of war.

Article 22 of the Concession reads as follows :—

> "When there is danger of war, in the actual time of war, or in case of internal disorders, the Government in the interest of the defence or of public order, may have the control of the railway and of everything required for the use of the same and suspend the ordinary traffic thereon, wholly or partially, and order all such measures as appear to it to be necessary, with reservation of compensation to the concessionary."

[1] In the through trains to Cape Colony whites were carried in "coloured" departments.

By decree of the Executive Raad, Article 858 of 13th September, 1899, use was made of the above right. The railway was withdrawn from the direction of the Z.A.S.M. and put at the disposal of the Government.

The decree of the Executive Raad says further :—

> "With the view of being able to make proper use of the railway, the whole *personnel* of the above-named Company, under Article 2 of Law No. 20 of 1896, is *commandeered* to do duty on the railway in the functions which they now occupy, and they are placed under the orders of the Commandant-General and the war officers indicated by him, or of other officials, with the understanding that those who can be spared by the railway may always be commandeered by the Commandant-General for ordinary war purposes."

From this it may be seen that the Company, under the terms of its Concession, was not only bound to convey the *personnel* and *matériel* of the forces of the Republic, but also to execute any other measures which were ordered, such as putting the traffic at the disposal of the Government, the exploitation of the railway in the occupied portions of Natal, the making and repairing of ammunition and guns in the workshops of the Company, etc.

Service Order No. 32.

Instructions for the Action of the Personnel in case of a Portion of the Line being taken Possession of by the Enemy.

"The *personnel* shall continue to perform their duties as long as possible, and not leave their posts of their own accord until these are taken possession of by the troops of the enemy.

The *personnel* must take no part in the struggle unless thereto commandeered by the lawful authority, and carry no arms on their persons whether on or off duty, and must not offer resistance to a regularly armed force.

If these orders are not obeyed the offenders will be held personally responsible.

If a portion of the railway is taken possession of by the enemy, the persons employed on that portion shall endeavour, in some way or other to get to portions of the railway which are not in the hands of the enemy, and place themselves at disposal for the Service again, unless their passage is obstructed by the enemy, or their remaining is desirable in the interest of a family.

No object can be gained either in the interest of the State or in that of the Company by defending the stations and the buildings against a regularly armed force.

If the occupation has been effected, the *personnel* shall cease working and leave the station or the line after having as far as possible put things in order.

The stationmaster, inspectors, and the other higher officials, must endeavour to obtain permission simply to exercise supervision over the furniture, material, tools, office requisites, and the books of the Company, or to hand them over in a regular manner.

In a general way, the principle must be adopted that no service shall be voluntarily done for the enemy. If in some cases, compulsion by threats is employed to get certain duties performed, the order shall be obeyed without raising objections, but the persons employed shall endeavour to get free as soon as possible.

The *personnel* shall be authorised to escape being made prisoners by promising to remain at their posts, and to take no part in the war.

A strict obedience to these provisions is earnestly enjoined on all persons, as well in their own interests as in those of the Company.

THE DIRECTION.

(Signed) J. VAN KRETSCHMAR.

Pretoria,

6th September, 1899."

Until now (April, 1900) the case anticipated in this order has not occurred, on the contrary, the Transvaal Railway Service has been extended beyond the frontiers.

One or two other questions with reference to the *personnel*, consequences of the peculiar condition of affairs, require mention.

Dating from the time when the Cape Government Railway managed the line from the southern frontier to Johannesburg there had been English subjects in several branches of the Z.A.S.M. During the period of pressure more Englishmen were taken on.

There were altogether in the traction traffic, permanent way, and works departments, about 115 English, besides about 540 Africanders from Cape Colony and Natal, actually British subjects, but mostly of Holland-Africander descent.[1]

Could these men be fully relied on, and entrusted with the safety of the line and the trains in case of war?

As a preliminary measure, as many as possible of the English were transferred to the portions of the system where it was probable they would have very little to do with war traffic, so that the South-Eastern and Southern portions could be manned by Hollanders and (non-English) Africanders. Later, after the outbreak of the war when the Government expelled the British subjects, permission to remain was only

[1] At the end of 1896, the total white *personnel* consisted of 3,051 persons.

asked for those of the English *personnel* who could not well be spared, and on whom the Company believed it could rely. The others had to go.

Some Englishmen remained in the railway service, and fortunately the confidence placed in them has not until now been betrayed. Among the *personnel* of the Company were about 350 burghers, partly Africanders from the Free State and Cape Colony. These were all by the law of the land liable for duty, and for the most part very anxious to do it.

In order to be assured that the railway should not lose more of its *personnel* than could be spared, an arrangement was made with the Government whereby none of the *personnel* should be commandeered who were necessary for the railway service; the Company was to point out the persons it did not require, and, in case it wished for men on commando, they were to be sent back.

Many took service voluntarily, by permission, when they could be spared; but with some the desire to fight was so great that they went on commando without leave of the Company, and thus lost their situations.

The relations between the Company and those of its *personnel* in military service were regulated by Service Order No. 33.

Service Order No. 33.

Commando Service.

"In case that by the laws of the South African Republic the persons in the employment of the Company are commandeered to take part in expeditions or to perform duties in any other way in connection with defence, the following provisions are enacted:—

1. If a person employed is commandeered, notice must be given by telegraph to the stationmaster of the section, who shall decide whether the service of the person concerned can be provided for. If this cannot be done without difficulty the stationmaster shall give notice thereof by telegraph to the Exploitation Service, the Chief Engineer, Service of Road and Works, respectively, according as the person belongs to one of these services.

   Endeavours shall be made through the Government Commissary to have the commandeering withdrawn.

2. The Company guarantees to those persons who can be spared half-pay if they are single, and two-thirds of their pay if they are married, *i.e.*, whenever the pay to be received amounts to less, the difference will be made up by the Company.

3. If any person employed wishes to volunteer for service, who has not been commandeered, and has been accepted by the military authorities, the stationmaster may give him leave, if the railway service admits of it, *without retention of pay*, and after payment of, or giving security for, whatever he may be eventually indebted to the Company.

   If his services cannot be dispensed with, he has to choose between giving up the military service and dismissal.

4. The persons mentioned under 2 and 3, so long as they are doing military or other services for the Government, shall be considered not to be in the service of the Company.

5. If the Government no longer requires the services of the persons commandeered or the volunteers, as soon as they have reported themselves to their immediate superior officer, they shall be taken on service again, so far as they are physically fit for it, with the grant of full pay, excepting those volunteers mentioned in 2nd paragraph under 3.

6. If persons who are in military service receive orders from the Exploitation Service or from the Chief Engineer, with the approval of the Government, to resume their service on the railway, they must obey the orders immediately, on pain of dismissal.

7. For the volunteers mentioned under 3, if a payment is made for them in the Netherlands, this shall be temporarily stopped, unless the money for it is paid out in advance, or satisfactory security is deposited.

8. The stationmasters must give orders to the Exploitation Service or the Chief Engineer respectively of all persons who are accepted for military service.

These provisions do not apply to persons employed who, by reason of engagements with the artillery corps, are called out for ordinary or repetition exercises. For this object the usual furlough shall be given, without retention of pay.

THE DIRECTION.

(Signed) J. VAN KRETSCHMAR.

Pretoria,

7th September, 1899."

After the great exodus of English subjects and after the mobilisation when the passenger and goods traffic so far decreased that the night service could be stopped on a great part of the system, a great number of the *personnel* were spared for war and guard duties. The state of things at the end of 1899 is shown by the following table :—

Personnel on Z.A.S.M. Railway in Transvaal ..	2,223
„ „ Natal Railway captured by the Z.A.R.	221
Personnel lent to the Orange Free State ..	27
„ „ „ Pietersburg Railway ..	4
„ of the Z.A.S.M. on commando or guard duty	576
	3,051

The guard duty mentioned above was under the Commandant-General, and is to be regarded as war service.

By reason of the great number of Anglophiles who, it must be assumed, were still in the Republic, and by reason of the long stretches of line in a sparsely inhabited country, it was necessary at first to watch very carefully against the attacks of evil-minded persons on the bridges and other points of the railway which might affect the safety of the trains or occasion disturbance of the traffic.

Guards were, therefore, placed at nearly all the larger bridges and other important points; they consisted partly of burghers, and partly of volunteers from the Hollander Corps, which itself consisted partly of the *personnel* of the railways. Except that at the beginning of the war dynamite carriages were sometimes found on the track (they were always removed in good time), no real attack on the line within the borders of the Republic was successful, or even got as far as execution.

II.—Mobilisation.

A modern European comprehends at once that the mobilisation of an Army takes place in pursuance of a pre-arranged and detailed plan, in which definite train time-tables are provided, founded on the number of troops and quantity of material, which have to be carried, and their place and time of shipment.

An Africander does not comprehend this; on the contrary, he does not think it necessary to arrange and fix every detail beforehand, he relies rather on finding a way out of a difficulty, and on making a plan as the necessity arises.

Until now this has answered pretty well, although things have not gone so smoothly and well as they might have done had more preparation been made.

Where there were deficiencies, the general good temper, patience, and facility for bearing privations have helped to overcome all difficulties. To within a few weeks of the war the highest military authorities were not convinced that it was necessary to prepare for the worst with every

means at their disposal; the hope that it would not be necessary kept everything back.

In spite of repeated endeavours, the Company did not succeed in obtaining any *data*, even of the vaguest character, as to the number of burghers, horses, and wagons which it would be necessary to convey from any particular station to another.

Even the total number of burghers who would be sent to any particular point of the frontier or to the frontier as a whole was absolutely unknown. One could only guess that if the English did not anticipate us (*ons niet voorkwamen*) by an invasion *viâ* Lang's Nek along the S.E. line, the greater part of the forces would be conveyed to the Natal frontier.

The case of an English invasion—about which there was much anxiety on account of the armoured trains which the English advertised so loudly—was prepared for only by preparing some of the bridges on the S.E. line for demolition.

On account of a total lack of *data* with regard to the stations which must be prepared for loading and unloading horses and ox-wagons, there was little to be done except to arrange for temporary platforms and ramps, so that it would be possible, somehow or other, to load cattle at stations where no arrangements existed. 20 cattle ramps (*vee laad bruggen*) and 20 temporary loading platforms were made, while others were, in haste, widened and improved.

In addition, timber and sleepers were deposited at various stations, so that temporary cattle loading docks could, if necessary, be made.

The general goodwill and the handiness of all Africanders in working with horses and oxen helped to overcome the difficulties which arose from the incompleteness of the arrangements and want of preparation.

Ox-wagons, guns, and ammunition wagons were by preference kept together in one train of the necessary number of trucks and put on by end loading, the intervals between the trucks being bridged over by planks, and the outward end arranged so that the carriages could not run over. Each gun and wagon, therefore, had to be pushed the whole length of the empty train by man power; when in position they were made fast by wedges and the wheels secured by leather *riems*.

The total lack of *data*, already alluded to, made it impossible to elaborate a time-table for the military traffic; it was, therefore, determined to stick, for the time being, to the ordinary schedule, to add special trains as they became necessary, and to keep some ready for use, which was very difficult, as the ordinary traffic to the frontier had to be kept up until the war actually broke out.

Instead of the frontier station Volksrust, where there is a large platform and ample arrangements for detraining wagons and animals, the station next before it, Zandspruit, was appointed by the military authorities as the place of assembly for the forces destined to invade Natal. The station has only one short piece of double line to allow trains to pass, a short siding and a small dock; extensions were of course made, but the station was wholly unsuitable for the *rôle* suddenly thrust on it; and this was the cause of unavoidable friction, so that the full carrying capacity of the S.E. Railway was only attained after several days. This, as the line was single, with stations about an hour apart, was limited to 11 trains a day in each direction. During this period two temporary crossing stations were laid out on the S.E. line.

To enable detraining to be carried on at night at Zandspruit, an electric light installation was erected in the early days of October; it consisted of 2 masts with arc lights worked by a dynamo on a locomobile.

After the most pressing commando traffic was over, the night service was stopped, with a view to security, on 15th October.

When the service to the commandoes was continued in Natal, it was necessary to introduce the night service again on the S.E. line in order not to lose too much time on the journeys. But in the portion of Natal occupied by the Boers the night service was never introduced, and traffic was worked almost exclusively by daylight.

Meanwhile, in consequence of an almost complete cessation of the ordinary traffic, important reductions could be made on the other lines.

The night service was given up on the sections Springs-Krugersdorp (the Rand Tram) and Witbank-Komatie Poort (the Eastern line minus its Western portion). By the latest traffic notice (4th March), trains will only be run by day on the Eastern line.

Besides this, with the exception of a few passenger trains between Pretoria and Johannesburg, the speed allowed was only that of mixed trains and goods trains.

In consequence of these limitations of the traffic, a large number of the *personnel* was freed and placed on the Natal Railway, lent to the O.F.S., or placed on military service, as already related.

The total military traffic to the frontier was not so great as one would expect in spite of only a portion of the burghers having taken up arms. From various districts the commandoes marched mounted, with ox-wagons, to the place of assembly, as had been the custom in the past, although the use of the railway would have saved time and trouble to both men and horses. Yet it was not the first time that the Transvaalers had had the opportunity of learning the use of railways in warfare. At the time of the Jameson Raid and the Magato Campaign full use had been made of them.

The first military train left Pretoria on the South-Eastern line, on 28th September, with a part of the artillery, consisting of 6 guns and timbers, 8 ammunition wagons, 60 men, and 105 horses.

The following table gives some figures of the war traffic:—

Date.	Men.	Horses and Mules.	Oxen.	Wagons.	Guns and Ammunition Wagons.	Goods (Tons).	Ammunition (Tons).
From 28th September to 10th October, to Zandspruit alone ...	8,369	5,381	1,907	308	8	1,525	93
From 28th September to 10th October, total military traffic ...	9,065	6,256	1,935	495	37	1,778	383
From 28th September to 31st October, total military traffic ...	13,413	13,271	3,203	1,077	53	3,972	683

After October, the whole military traffic could be carried out quite easily with a reduced service.

Beyond the ordinary despatch of slaughter-oxen and other supplies, and horses and ammunition, and the conveyance of the many burghers who were always going on leave or returning, and generally took their horses and goods and frequently their ox-wagons with them, the traffic offered no special points of interest.

Use was also made of the railway to transfer whole commandoes from Natal and from the Western border of the S.A.R. to the Free State. A medium train for a commando with wagons carried about 125 men with the same number of horses, 3 ox-wagons, 30 oxen, 1 wagon, and 16 mules. The typical composition of such a train may be taken as 4 first and second class carriages, 16 cattle trucks, 4 low-sided trucks, 2 goods trucks, and 1 luggage van—altogether 27 vehicles.

Whenever there were no ox-wagons, or whenever these were sent separately, a medium train for a commando took about 200 men with horses and baggage, and consisted of 6 carriages, 20 cattle trucks, and 1 luggage van, or 27 vans as before.

With such a train a number of Kaffirs usually went as followers and servants; they found places as best they could.

With 2 engines the number of trucks was 40 to 50.

The rolling stock consisted of:—

Carriages, first class - - - - - -	142
,, second class - - - - - -	44
,, for coloured persons - - -	49
Coal trucks - - - - - - - -	2,530

Cattle trucks	541
Closed goods trucks	477
Timber trucks	375
Long coal trucks	979
Platform trucks	10

In consequence of the exodus of foreigners on the outbreak of war and the interruption of the traffic with Natal and Cape Colony, of these carriages and trucks there were 194 in Natal (of these 26 were recovered later) and 222 in Cape Colony; the loss was made good by 252 Natal trucks which were found in the occupied part of Natal, and the Natal and Cape trucks which were on the Z.A.S.M. lines at the beginning of the war. Notwithstanding, there were not enough cattle trucks and far from sufficient platform trucks for the transport of guns and ox-wagons.

As in consequence of the decreased coal traffic, only a small number of coal trucks were required, and there were also trucks used for the transport of rails and long timbers available. Three hundred and fifteen coal trucks were converted into cattle trucks by the addition of temporary partitions, and 139 coal trucks and 223 timber trucks were made into platform trucks by taking away the sides and saddles.

III.—Operations in Natal.

When, in the course of September, diplomatic relations were strained to breaking point, and the conviction gained ground that England wanted war and would force it, either by demanding more than the Republics could grant or by some other means, it was to be anticipated that the Transvaal would take the initiative and attack. By doing so they would ensure a certain advantage as long as the English Army in South Africa was still weak.

This actually took place, although the advantage was nearly all lost through lack of activity before Ladysmith and Kimberley and the raising of the sieges.

For a long period, however, it was expected that the English would make the first attack, and it was thought that the war would begin with an invasion of the Transvaal from Natal over Lang's Nek. The Government did not wish to give a pretext, by assembling burghers on the frontier, for this invasion to be easily carried out.

Certain positions only were fixed, at which an attempt was to be made to hold the enemy; the necessary measures to make the railway unserviceable were also taken, among others an iron bridge of 166 feet span was prepared for demolition.

In order to be able to telegraph from a station up to the latest moment, the instruments were shifted from the usual offices to other

rooms, so that if the station was suddenly attacked information could be sent; the necessary precautions were also taken to prevent the enemy destroying the apparatus by turning on a strong current.

But none of these measures have, until now, been of use, for the course of events was not that which was anticipated.

The English were surprised by the initiative of the Republics, did not feel themselves strong enough, retired in all haste from the frontier in order to concentrate at Dundee and Ladysmith, and the Boers entered Natal without encountering resistance.

On 14th October the Commandant-General gave the order to man the Natal Railway and to work it for military traffic. As the commandoes advanced, the Natal line was opened as follows:—

17th October	to	Newcastle - -	62	kilometres.
20th ,,	,,	Dannhauser -	98	,,
22nd ,,	,,	Hattingspruit -	110	,,
25th ,,	,,	Glencoe - -	122	,,
27th ,,	,,	Dundee (branch line)	9	,,
2nd November	,,	Elands Laagte -	171	,,
7th ,,	,,	Modderspruit -	187	,,

Before a new section was opened, a careful examination of its condition was of course made.

It appeared that the English railway *personnel* had retired in a great hurry, that they had not attempted any demolitions and had not done any damage of importance: the Lang's Nek tunnel was wholly untouched.

At a few places the rails were unspiked, which was easy to repair: the points at one place on the main line had been taken away and all the telegraph instruments had been removed.

The Boers themselves, however, through fear of being surprised by armoured trains, and for other reasons, gave the breakdown gangs more work to do. The telegraph line was destroyed by them for long distances, the track was broken up and a couple of bridges damaged. In order to obstruct the retreat of General Yule from Dundee a bridge of two 30-foot spans on the Dundee branch line was blown up, by the Irish Brigade, with a dynamite charge in the central pier. The damage done was not very great, and was easily repaired. The same ineffective method was applied with greater success to a similar bridge over a small spruit near Waschbank. But even here the repair was not difficult.

In consequence of the ineffective guarding of the line in Natal, some Englishmen succeeded in damaging the big bridge over the Waschbank on the night of the 8th-9th December.

The bridge consisted of two 100-foot spans; it was only guarded by two Kaffirs, who ran away.

The attackers were too hasty about their task, and only managed to cut through the top flange at the end of one girder, near the centre pier, with a charge of dynamite; the lower flange was undamaged, and the bridge remained in position. The Kaffirs brought intelligence of the attack, so that the approaching train could be stopped until the repairs were completed. They consisted simply of a pier of wooden sleepers under the end of the second section; by 2 p.m. the bridge was again ready for traffic.

The bridge over the Sunday River was also damaged by dynamite by evil-disposed persons on the night of the 29th-30th November while the guard was asleep, but not seriously.

On 2nd November, 1899, the station at Elands Laagte was opened; it was intended to be the end station of the regular service and the commissariat depôt. A pair of points and some line were laid.

Supply trains were forwarded to the Boer headquarters at Modderspruit, and at this point of the line, about 5 or 6 miles from Ladysmith, a temporary station was erected, a semi-circular line and two sidings laid, and a platform of sleepers and planks make. Later on a goods loading dock, taken from the Ingagane Station in Natal, was erected.

Various stations in Northern Natal had been extended by the English with a view to large movements of troops, and provided with long high platforms for detraining cavalry and increased water supply, improvements which came in very handy for the Federal Army.

The telegraph lines were repaired as the Army advanced, and 24 telegraph instruments were put up in the stations. On account of its simplicity and the small number of cells required, the American intermittent current system was used in Natal.

At the end of November, when General Joubert returned from his invasion of Natal to the north bank of the Tugela, this naturally magnificent position was occupied by the Boers.

The Tugela bridge at Colenso was destroyed. The destruction was carried out under the immediate orders of the military authorities by an inspector of the Company, who, like many others, had served in the Dutch Engineers, and was therefore no stranger to demolition work.

The bridge consisted of five iron lattice girder spans of 100 feet each, on masonry piers. In each of the spans a dynamite charge was placed, at an interval of one-third of the length from one end, against each of the lattices, the upper and lower flanges, the web, etc., so that there were about forty charges altogether, all connected by leads to a Siemens and Halske "exploder." The forty charges detonated at the same moment and the bridge was very thoroughly demolished. One of the stone piers was afterwards levelled to the ground.

The bridge over the Orange River at Norval's Pont was also blown up by the Z.A.S.M. *personnel*.

Three spans were destroyed by dynamite charges placed against the upper and lower flanges and the web. On account of the trough shape of the flanges the dynamite was placed between the iron and a wood core about 4 inches thick, which was spiked to a plank fastened under or above the flange.

Such a charge takes about eighty cartridges or about 11 lbs. of dynamite. But in this case the explosive was not used grudgingly, as for the three spans about 3½ chests of dynamite, or 198 lbs., were used.

The explosion of the charges took place simultaneously with the help of a Siemens "exploder." Nothing was done to the iron piers, as they fell of themselves.

The road bridge, close to the railway bridge at Colenso, was not destroyed. This was done by English shell during the battle of Colenso (15th December, 1899).

On the section Colenso-Ladysmith one small bridge near Nelthorpe was destroyed earlier during the investment of Ladysmith.

In order to be able to reach the Tugela position easily, the Commandant-General judged it desirable to make a road bridge over the Klip River on the Elands Laagte road near Colenso. This bridge was built alongside the existing drift, which is a very bad one. It was about 166 feet long and was wholly made of 3-inch by 9-inch timbers; it was anchored with steel cables as precaution against floods.

In order to obtain communication with the positions which the Boers still held on the south of the Tugela, another small bridge, suitable for foot passengers, horses, and, in cases of need, for vehicles, was thrown over the river by the *personnel* of the Z.A.S.M. It was built near the so-called Bosch Kop or Monte Christo. It consisted simply of baulks laid in the shallow river and anchored from rock to rock by cables: the roadway was formed by wooden sleepers, which were taken from the neighbouring railway, and held together by a rail at each edge. The sleepers were 7 feet 4 inches long, and thus formed a roadway of quite sufficient breadth.

After the Boers had given up these positions, in the night of the 19th-20th February, they burnt this bridge as well as the flying bridges which had been made in the neighbourhood.

As the wagon road was extraordinarily bad, the Commandant-General intended to improve the communication with the Tugela positions by taking into use the piece of railway from Nelthorpe *viâ* Pieters Station to the foot bridge on the Tugela; an order to this effect was given on 17th November.

This piece of line, about 11 kilometres long, was very little damaged; only a small bridge near Nelthorpe required repair. There were some open goods trucks of the Natal Railway left behind on it, which were sufficient for the purpose, but there were no locomotives. These could only be brought from Modderspruit, more than 20 kilometres off, by a very bad road.

Two 19-ton locomotives were partly dismantled at Johannesburg. The boiler was loaded on one very strong lorry, such as is used to move boilers, the under carriage on another, and they were placed, lorries and all, on railway trucks.

The transport over the wagon road was very troublesome, on account of the hills, mud drifts, and high water. But both engines got to Pieters on the 28th December, and the 30th December were ready for service.

The piece of line was opened for traffic on 3rd January. The line was naturally not very much used, its very short length hardly made the saving in transport over a bad road worth the trouble and loss caused by two extra loadings and unloadings.

In the last days of February, when the Colenso position and Ladysmith were abandoned, the two locomotives were left behind, after they had been disabled by removing the connecting rods.

In the same manner as above described, a locomotive was transported from Modderspruit to Smith Crossing, a ferry on the Ladysmith-Harrismith line, in order to work the line on which only one locomotive had been left behind.

On the relief of Ladysmith, both these locomotives were removed out of the reach of the English in good time.

The obvious idea of making a loop line round Ladysmith, *e.g.*, from Modderspruit along the Boer positions to Pieters, was also considered, although it looked like a long job, but it was abandoned on account of the great distance and the difficulties of ground.

When, on 18th February and following days, General Buller at last succeeded in gaining possession of the important positions on the south side of the Tugela, and was pressing forward from them—which in conjunction with the disasters in the Free State led to the abandonment of the siege of Ladysmith—the Council of War decided to occupy the Biggarsberg positions.

On 1st March, the last train left Ladysmith, only leaving behind a couple of Natal goods trucks which were off the line, and had been used for dwellings by the *personnel*.

The last train was barely away before shells fell in the station.

The retirement of the railway *personnel* and *matériel* to Glencoe was carried out in perfect order. All telegraph instruments were taken away.

In the afternoon and night of the 1st March, the so-called "demolition train" followed. All the bridges, many masonry culverts, and the water reservoirs were blown up.

These reservoirs are tanks about 3 feet 4 inches high, formed of cast-iron plates of a fixed model, so that the tanks can easily be enlarged. They stand on cast-iron pillars; one or two of these columns were destroyed and the tank then fell to pieces.

The demolition of the bridges was carried out in the same manner as the Colenso bridge. There was no lack of explosives nor necessity to spare them, so there was no uncertainty about the results.

The railway service in Natal was now much simplified. Hattingspruit, about 110 kilometres from the frontier, was the end station, while supply trains went as far as Glencoe (122 kilometres).

The working of the Natal line was from the nature of the case very irregular, for commandoes were shifted at very short notice, that nothing might leak out about their movements. Much was therefore demanded of the *personnel*, but the administration was extremely simple.

All traffic took place on Government traffic orders, there was no private traffic, therefore no receipts, and no responsibility. On the other hand, all cost of *personnel* and *matériel* was charged against the Government.

As long as they held out, use was made of the stores left behind on the line, such as coal, etc.; the Service Orders were printed by the Volksstem press, which was carried in a railway carriage, on the menu cards of the station restaurants.

The Natal coal mines, which all lie north of the Tugela, fell undamaged into the hands of the Federal States, but they were not worked, so that the coal needed for the Natal line, as soon as the supplies found had been used up, had to be obtained from the Transvaal.

IV.—The Workshops.

In conclusion, there remains a portion of the work of the Z.A.S.M. to be described that certainly has contributed not less than anything else to the comparative success of the Republican Army and to make the continuation of the war a possibility.

One of the things which the War Department of the S.A.R. had neglected to provide in the years which preceded the war and followed the Jameson Raid was an arsenal.

There were indeed guns, of the best type, although not many of them, and rifles and a great quantity of ammunition; but there were no workshops for the manufacture of cartridges, shells, and what, in general, are called projectiles. Shops speedily became desirable also for the repair of guns, rifles, and wagons, for the manufacture and repair of harness,

saddles, and a hundred other things which belong to the indispensable equipment of an Army.

By the so-called commandeering, *i.e.*, forced sale to the Government, as well as from abandoned warehouses and the shops which still remained open, the men were more or less provided with clothes, shoes, and many other articles; while later on a few workshops were improvised.

Rifle cartridges were made by the Transvaal Explosive Company (Maatschappij voor Ontplofbare Stoffen) and by Delfos Brothers of Pretoria; gun ammunition was made by both the above, by a workshop at Johannesburg, which was commandeered by the Government and placed under the care of the representative of Creusot, and by the central workshops of the railway at Pretoria.

The last alone was in a position to execute repairs to guns.

The Government made great use of the powers, which it had by virture of the concession over the workshops as part of the railway.

Although the work on the maintenance of the railway material was limited to the absolutely necessary, it became necessary to introduce regular night work in the shops, and a whole electric light installation was put up for the purpose.

Among the most interesting work which was carried out in connection with the war must be mentioned four complete ambulance trains. Each consisted of a hospital car, 2 passenger cars, 5 luggage vans, and a closed good trucks. Of the luggage vans, 3 were without special fittings, 1 was provided with chests, filters, water-tank, and a petroleum store, and the fifth, in addition, with a heating stove.

The hospital cars were mounted on a big frame carried by 2 bogies. One car had 32 and the other 20 beds; these were fitted with wire mattresses, except one or two, which were provided with wooden bottoms for wounded who could not stand the movement of the wire mattress.

Of the work which was done of the artillery, I shall only mention the most important. A 15·5-centimetre Creusot gun, named Long Tom, that was injured by a night sortie of the English to Lombard's Kop (near Ladysmith) in December, left the workshops in January wholly fit for service. The bore was badly injured by a dynamite charge at a short distance from the muzzle, the breech was also damaged, and the breech block lost. The gun was shortened at both ends, about 16 inches in all, the chamber was shifted forward, a new screw thread cut, and a new breech block made. The gun appears not to have lost either in accuracy or in range.

The Krupp howitzer that was also injured at Ladysmith—by a dynamite charge that was placed on top of the gun and caused a dent in the bore—was also repaired, the dent removed and the grooves re-cut.

In place of a similar Krupp howitzer, which was so much damaged that it could not be repaired, a completely new one was constructed on the model of the damaged one. Steel that stood the same tests as the model was found in Johannesburg in the form of a heavy machine shaft. This gun is still in use.

A number of repairs were also done to large and small guns and Maxims.

Three timbers and platforms were made for the 15·5-centimetre Creusot guns, and the wheels of many guns were repaired and renewed.

Howitzer projectiles with steel points, intended for use against armoured trains, were also made. But by far the most work was done in casting and turning time and percussion fuses, which, as already reported, was done in co-operation with other factories.

(Signed) TH. STEINMETZ,
Secr. der N.Z.A.S.M.

Pretoria,
April, 1900.

NAVAL NOTES.

HOME.—The following are the principal appointments which have been made: Captains—J. L. Marx to "Grafton" and then to "Warspite"; C. R. Keppel, C.B., D.S.O., to "Grafton"; C. J. Briggs to "Vulcan"; G. A. Callaghan, C.B., to "Cæsar"; H. A. W. Onslow to "Camperdown"; A. C. Corry to Medway Fleet Reserve; C. H. Robertson, C.M.G., to "Pallas." Commander—E. G. Barton to "Espiegle."

The first-class cruiser "Grafton" is to be commissioned to relieve the first-class belted cruiser "Warspite," as the flag-ship of Rear-Admiral A. K. Bickford, C.M.G., in the Pacific. The second-class cruisers "Dido" and "Isis" arrived from China on the 14th and 17th ult. respectively, and will pay off at Chatham. The second-class battle-ship "Barfleur," flying the flag of Rear-Admiral Sir J. Bruce, K.C.M.G., late second-in-command of the China Squadron, arrived at Plymouth on the 31st ult., and will pay off at that port. The second-class cruiser "Rainbow" commissioned at Devonport on the 18th ult. for service with the Training Squadron and has since joined Commodore Winsloe's broad pennant. The third-class cruiser "Pearl" commissioned at Devonport on the 17th ult. for service on the Cape station, and left on the 3rd inst. for her destination. The sloop "Melita," the only vessel of war which has ever been built at Malta, arrived at Plymouth on the 11th ult. from the Mediterranean, on which station she has been relieved by the new third-class cruiser "Pandora." The new sloops "Vestal" and "Mutine" and the third-class cruiser "Fearless" left Sheerness on the 14th ult. for China, where they relieve the "Daphne" "Redpole," and the "Brisk," respectively, while the new sloop "Rinaldo" left the same port on the 21st ult. to relieve the first-class gun-boat "Plover," also in China. The new river-gunboats "Moorhen" and "Teal" are to be commissioned at Hong-Kong and Shanghai respectively, on the arrival of the "Iphigenia" with their new crews.

Floating out of New Ships.—The new sloops "Merlin" and "Odin," which were floated out on 30th November, were laid down on 11th February, and built side by side. They are sister ships in every respect except one, the "Odin" being fitted with the Babcock and Wilcox water-tube boilers, while the "Merlin" will have Belleville boilers. The "Merlin" was to have been fitted with the Niclausse water-tube boilers, but as they were completed for delivery some months before the ship was ready to receive them, they were placed in the sloop "Fantome," which will shortly undergo her trials. The Belleville boilers made for the "Fantome" will be supplied to the "Merlin." The "Merlin" and "Odin" are 185 feet in length, and have a beam of 33 feet 1½ inches. They will have a displacement of 1,096 tons, and will draw 11 feet of water forward and 11 feet 6 inches aft. Their armament will consist of six 4-inch Q.F., four 3-pounder Q.F., and three ·303 Maxim guns. Their engines are to be of 1,400-H.P., and they will have a speed of 13·25 knots per hour. The "Odin" will be fitted with machinery and boilers supplied by the Wallsend Slipway and

Engineering Company. The engines of the "Merlin" have been made at Sheerness Dockyard. The new sloops will be barque rigged, and each will have accommodation for a crew of 113 officers and men.

War-ship Building in 1901.—The ships launched during the year 1901 will form a larger addition to the British Navy than those floated in any preceding year. The thirty-two vessels floated, embracing every type from the submarine-boat to the first-class cruiser and first-class battle-ship, make up a total displacement tonnage of 209,100 tons, which compares with 35,604 tons in the concluding year of the century. But, as we pointed out a year ago, the conditions were somewhat abnormal, many of the vessels being delayed on the stocks owing to circumstances associated with armour-plate manufacture which need not be entered into here, so that it is only fair to strike a mean between the output of the two years, and from this standpoint the result is not unsatisfactory. From the five dockyards eight vessels, totalling 64,910 tons, have been floated. This is not an exceptionally large output when compared with normal years, although it greatly exceeds last year's subnormal production. But it is specially notable that the facilities in the dockyards for carrying out work expeditiously have been greatly increased, Sir James Williamson, the Director of Dockyards, having with characteristic progressive spirit installed a very large number of modern machine tools: but with a greatly increased fleet, the extent of repair work must necessarily grow, and consequently the establishments have of late years been devoted more and more to such overhaul work.

During this year the dockyards have been engaged on the completion of thirteen new ships for commission, including three battle-ships and several cruisers, while, at the same time, over twenty vessels have undergone extensive repairs and refits, in addition to the overhauling of the ships forming the Reserve and Channel Squadrons—a programme which at once indicates the extensive work done, apart altogether from new shipbuilding; but it would be a mistake to discontinue to any great extent the new work undertaken, because of its educational value, and of the necessity to keep the men fully employed when repair work is slack, as occurs at seasons; besides, without new construction the standard of excellence of workmen necessary for repairs might not be so easily maintained, and it is a subject for consideration whether in the future it might not be desirable to send ships for extensive overhaul to their original builders, rather than to diminish the amount of original constructive work carried out in the dockyards. This course is preferable to adding largely to the numbers now employed in the dockyards. It will also tend to educate private firms in this important class of repair work, and this will be invaluable in times of emergency, especially when ships might be disabled at or near our large shipbuilding and repairing centres.

From private yards there have been launched twenty-four British war-ships, of 144,190 tons, which is greater than in any year during the past decade—if, indeed, it has ever been excelled in the history of war-ship building. It is double the output of 1898, compares with 53,222 tons in 1899, and is almost five times the total of last year. Similarly, the H.P. is much greater; but the difference here is not quite so marked, owing to the fact that comparatively few torpedo craft are included this year: and when it is noted that the fastest battle-ship has barely 1·3-H.P. per ton displacement, and the cruiser 2-H.P. per ton, whilst the destroyer has 20-H.P. per ton, this difference in the ratios of increase of power and of tonnage will be easily understood. Of the thirty ships launched for the British Fleet, six were battle-ships of the "Duncan" class, ten were armoured cruisers, three sloops, two shallow-draught gun-boats, two torpedo-boat destroyers, four torpedo-boats, and three submarine boats.

The following table shows the number and displacement of the ships launched or floated out at the home dockyards since 1899, along with their total cost and the average cost per ton :—

Year.	No.	Total displacement.	Total cost completed.	Average cost per ton.
		Tons.	£	£ s. d.
1890	8	22,520	1,230,913	49 0 0
1891	8	68,100	3,847,596	56 10 0
1892	9	50,450	2,920,431	58 0 0
1893	9	32,400	1,728,431	53 0 0
1894	8	26,700	1,803,516	67 10 0
1895	8	70,350	4,399,691	60 10 0
1896	9	71,970	4,287,000	89 12 0
1897	4	31,885	1,732,700	85 0 0
1898	8	70,955	1,441,000	62 12 0
1899	6	66,900	1,901,000	73 3 0
1900	4	5,230	394,600	75 9 0
1901	8	64,910	4,901,169	69 9 0

The vessels launched during 1901, are shown in the following return :—

Vessel.	Type.	Displacement.
	Pembroke.	
"Drake"	Armoured cruiser...	14,100
"Essex"	Armoured cruiser..	9,800
		23,900
	Devonport.	
"Montagu"	Battle-ship...	14,000
	Chatham.	
"Albemarle"... ...	Battle-ship...	14,000
	Portsmouth.	
"Kent"	Armoured cruiser...	9,800
	Sheerness.	
"Fantome"	Sloop	1,070
"Odin"	Sloop	1,070
"Merlin"	Sloop	1,070
		3,210

Work on Hand.—The work on hand includes four battle-ships, three armoured cruisers, two second-class cruisers, and two sloops. The following shows where they are being built :—

	Displacement.
Devonport.	
Battle-ship "Queen"	15,000
New battle-ship...	16,500
Protective cruiser "Encounter"	5,880
	37,380
Chatham.	
Battle-ship "Prince of Wales"	15,000
Protective cruiser "Challenger"	5,880
New armoured cruiser	9,800
	30,680

	Displacement.
Portsmouth.	
Armoured cruiser "Suffolk"	9,800
New battle-ship	16,500
	26,300
Pembroke.	
Armoured cruiser "Cornwall"	9,800
Sheerness.	
Two sloops (each 1,050)	2,100
	106,260

Marine Engineering.

Dockyard.	1901.	1900.
	I.H.P.	I.H.P.
Devonport	1,400[1]	—
Portsmouth	—	7,000
Sheerness	—	1,400
Totals	1,400	8,400

[1] The vessel engined was the sloop "Fantome."

Prize Firing in the Channel Squadron.—The return of the annual prize firing with heavy guns of the Channel Fleet ships has recently been published. In the case of the 13·5-inch gun two runs of 6 minutes for each gun were made, but for the 12-inch guns one run of 6 minutes was made for each gun. The results were as follows :—

Ship.	Gun.	No. of Gun.	Rounds.	Hits.
	inch.			
Repulse	13·5	4	25	10
Resolution	13·5	4	28	9
Mars	12	4	26	11
Majestic	12	4	22	7
Magnificent	12	4	23	7
Prince George	12	4	26	7
Hannibal	12	4	22	6
Jupiter	12	4	20	6

In the case of the 6-inch guns one run of 2 minutes was made, the result being :—

Ship.	Gun.	No. of Gun.	Rounds.	Hits.
	inch.			
Mars	6	12	112	62
Majestic	6	12	123	52
Repulse	6	10	77	39
Jupiter	6	12	97	42
Resolution	6	10	61	31
Hannibal	6	12	84	35
Prince George	6	12	96	34
Furious	4·7	6	73	26
Arrogant	4·7	6	63	19
Minerva	4·7	6	68	28
Pactolus	4	8	95	20

The result of the annual prize firing in the Channel Squadron must be gratifying to Vice-Admiral Wilson and to his predecessor, Sir Harry Rawson, during whose period of command there was a great revival of interest in gunnery. The shooting by the 13·5-inch guns of the "Repulse" and the "Resolution" is remarkable, as these weapons have never enjoyed a high reputation: yet the "Repulse" secured 40 per cent. of hits, and the "Resolution" 32 per cent. The best firing with the 12-inch gun was made by the "Mars," which secured 42 per cent. of hits, whereas the five other ships of the squadron armed with the same gun averaged only about 30 per cent. The "Mars" is evidently the crack ship of the squadron in gunnery, for with the 6-inch gun she averaged 55 per cent., making 62 hits with 112 rounds. The "Repulse," though firing only 77 rounds, made 50 per cent., while the "Majestic," firing 123 rounds in the same time, made 52 hits, or 42 per cent. The other ships armed with the 6-inch gun were content with a mean of from 30 to 35 per cent., though in each case the firing was much slower than in the case of the "Mars" and the "Majestic." With the 4·7-inch gun the "Furious" was the only ship that came anywhere near 30 per cent., which is disappointing, having regard to the fact that the 4·7-inch has the reputation of being the most accurate gun in the Service.

Transport to South Africa.—A Parliamentary paper (374) just issued contains a return by the Admiralty showing the name, tonnage, and speed of each vessel employed to convey troops to South Africa between 1st April, 1900, and 31st March, 1901, the date and port of her departure and arrival at Cape Town, Durban, or elsewhere, respectively, including arrival at and departure from intermediate port of call; the number of troops and horses or mules carried on each occasion, the number of horses or mules lost on voyage, vessels provided with new pattern fittings, vessels provided with old pattern fittings, vessels provided with slings for each horse or mule, vessels not so provided; and the time occupied by each vessel in making the voyage. From this return it appears that within the period mentioned 3,179 officers, 79,655 men, and 21,225 horses were carried from this country or from the Mediterranean, the vessels employed making 142 voyages, during which 1,200 horses were lost on the way. No ships were wrecked. For the conveyance of mules to South Africa 41 passages were made, 42,099 mules being conveyed, out of which only 1,407 were lost. Four passages were made from Australia, 126 officers and 2,184 men, with 2,570 horses, of the colonial contingents being carried. In the conveyance of horses and cobs from North and South America, Austria, and Australia to South Africa 90 passages were made, 76,214 horses being carried and 2,936 lost on the voyage. The latter figures include the 903 horses lost by the wreck of the "Suffolk," the only wreck which occurred among the transports.—*Times* and *Naval and Military Record.*

FRANCE.—The following are the principal promotions and appointments which have been made: Rear-Admirals—C. L. T. Courrejolles to be Vice-Admiral: H. A. Boutet to command a division of the Mediterranean Fleet. Capitaines de Vaisseau—J. J. Bugard, F. A. Leygue to be Rear-Admirals; P. B. Fortin to "Pothuau"; J. A. de Surgy to "Gaulois"; L. T. De Mazenod to "Henri IV." Capitaines de Frégate—C. H. Archimbaud to "Vaucluse"; A. J. Bouxin to "Nièvre."—*Le Journal Officiel de la République Française.*

Rear-Admiral Boutet has been selected to succeed Rear-Admiral Caillard in command of the Light Division of the Mediterranean Fleet, and will hoist his flag on board the first-class armoured cruiser "Pothuau" on the 14th inst., with Capitaine de Vaisseau Fortin as his flag-captain. Rear-Admiral Jauréguiberry, who occupies the post of Chief of the Staff at Cherbourg, is to be transferred in a similar capacity to

Toulon, his place at Cherbourg being taken by Rear-Admiral Borel de Brétizel. Vice-Admiral Gigault de la Bedollière, Commander-in-Chief of the 3rd Arrondissement Maritime (Lorient), died suddenly on the 19th December; the duties of the command are being temporarily carried out by Rear-Admiral Rivet, the Chief of the Staff.

Naval Construction in 1901. — No new large vessels were commissioned during the year, though some were far enough advanced to undergo their trials in whole or in part. Among these are the battle-ship "Iéna," which has undergone her trials with success, during which she easily realised a speed of 18 knots, and she will shortly be commissioned; the armoured cruiser "Montcalm," which has not yet completed her trials, but has made 21 knots; the first-class armoured cruiser "Jeanne d'Arc," which so seriously damaged her boilers on her trials that the necessary repairs will take some months; and the first-class cruiser "Chateaurenault," whose boilers were satisfactory, but whose engines have proved to be too weak. In 1902 these four will probably take their place in the French Navy, and others will do likewise, or at least be ready for their trials. These others are the second class battle-ship "Henri IV.," the first-class battle-ship "Suffren," the first-class armoured cruisers "Gueydon," "Dupetit Thouars," "Dupleix," "Marsellaise," and "Desaix," and the first-class armoured cruiser "Jurien de la Gravière."

A number of smaller craft have been added to the Navy during the year, including the torpilleurs de haute mer "Trombe," "Siroco," "Mistral," and "Simoun," of 26 to 28 knots; the "Borée" and "Tramontane," of nearly 30 knots; several first-class torpedo-boats of 25 knots, and the two torpedo-boat destroyers "Pique" and "Epée." Of the submarines, the "Français" and "Algérien" have entered the Service at Cherbourg, and the "Farfadet" and "Lutin" have begun their trials at Rochefort. The four submersibles "Sirène," "Triton," "Espadon," and "Silure" have undergone their trials successfully at Cherbourg. The chief improvement in submersibles has been the reduction in the time required to submerge them. Of the large vessels included in the new naval programme only one, the armoured cruiser "Léon Gambetta," has been launched.

The following is a list of the ships in hand at the various ports at the end of 1901 :—

Havre.—Normand has in hand some torpedo-boats of the "Arquebuse" and "Arbalète" types, while the "Rafale" and "Bourrasque" are undergoing their trials; the Forges et Chantiers are building the "Libellule, a torpedo-boat to be fitted with turbines.

Cherbourg.—The second-class battle-ship "Henri IV.," which is ready for her trials; the armoured cruiser "Jules Ferry," which is on the slips, but which will hardly be launched in 1902; the coast-defence-ship "Furieux," which is undergoing extensive alterations; and several submarines of a new type.

Brest.—The first-class battle-ship "Iéna," which has just finished her trials; the first-class battle-ship "Suffren," launched in 1899; the first-class armoured cruiser "Marsellaise," launched in 1900; the first-class armoured cruiser "Léon Gambetta," launched a few months back; and the second-class battle-ship "Devastation," which is undergoing extensive alterations; preparations have also been made for the laying down of the battle-ship "République."

Lorient.—The first-class cruiser "Jurien de la Gravière" and the armoured cruiser "Gueydon" are nearly ready for their trials; and two first-class armoured cruisers of the improved "Gueydon" type, the "Gloire" and "Condé"; the "Gloire" has received the greater part of her machinery.

Nantes, Saint Nazaire.—The first-class armoured cruiser "Desaix," for foreign stations, which will probably complete her trials during 1902; and the "Amiral Aube" of the "Gloire" type, which will not be ready for her trials before 1903; there are also in hand several smaller craft.

Rochefort.—The first-class armoured cruiser "Dupleix," of the "Desaix" type; the four torpedo-boat destroyers "Pertuisane," "Escopette," "Flamberge" and "Rapière," which are rapidly approaching completion, and will be followed on the slips in 1902 by the "Carabine," "Sarbacane," "Francisque," and "Sabre"; and the submarines "Gnome," "Farfadet," "Lutin," and "Korrigan."

Bordeaux.—The first-class armoured cruiser "Kléber," of the "Desaix" type, and several first-class torpedo-boats.

Toulon. — The first-class armoured cruisers "Dupetit Thouars" and "Jeanne d'Arc," and several submarines of a type intermediate between the "Morse" and "Gymnote"; preparations are also being made for laying down the first-class armoured cruiser "Victor Hugo," of the "Jules Ferry" type.

La Seyne.—The first-class armoured cruisers "Sully" and "Montcalm," and the first-class cruiser "Chateaurenault."

According to the report of the Naval Budget for 1902, which M. Lockroy has just presented to the French Chambers, the following vessels were ordered to be put in hand in 1902:—

Government Yards.—The first-class battle-ship "République," the first-class armoured cruiser "Victor Hugo," the torpedo-boat destroyers "Francisque" and "Sabre," and twenty-two submarines.

Private Yards. — The first-class battle-ship "Patrie," seven torpedo-boat destroyers, and eleven torpedo-boats.

The following are the names of the sixteen torpedo-boat destroyers, which are not mentioned by name as in hand above:—The "Arquebuse," "Arbalète," "Mousquet," "Javeline," "Sagaïe," "Epieu," "Harpon," "Fronde," "Dard," "Baliste," "Mousqueton," "Arc," "Pistolet," "Bélier," "Catapulte," and "Bombarde."

The new submarines bear the following names:—"Naïade," "Protée," "Perle," "Esturgeon," "Bonite," "Thon," "Souffleur," "Dorade," "Lynx," "Ludion," "Loutre," "Castor," "Phoque," "Otarie," "Méduse," "Oursin," "Grondin," "Anguille," "Alose," and "Truite"; there are also three of a new type and of larger dimensions, which are at present known as Q35, Q36, and Q37.

Trials of Submergible and Submarine Boats.—The submergible torpedo-boat "Triton" proceeded from Cherbourg on 7th December for a twenty-four hours' trial. After having embarked her stores and her four torpedoes, she left port at 10 a.m. under steam. When outside the breakwater she made a submerged trial for two hours under electricity. On coming to the surface fires were again lighted, and she continued her trial under steam as far as Cape la Hève, and during this time the electric accumulators were recharged. The return to Cherbourg was effected under rather adverse circumstances, the weather having become so bad that all appertures had to be closed, causing the temperature in the engine-room to rise to 50° C. (122° F.); the crew, however, stood this excessive heat well. The trials were considered satisfactory, and she returned to Cherbourg arsenal the next morning.

The "Silure," another submergible boat, also had trials of her machinery at Cherbourg with satisfactory results. She took 10 minutes to perform the operation of submerging, but it is expected that when the crew have had more practice this will be accomplished in 6 minutes.

On 24th December the three submarines, "Morse," "Algérien," and "Silure," made a torpedo attack on the coast-defence battle-ship "Bouvines" in Cherbourg roads. The "Bouvines" was to endeavour to discover them and destroy them with her light guns. Two of the submarines were successful in torpedoing the "Bouvines" without being perceived, the third, the "Algérien," was less fortunate, and was discovered and considered to be out of action.

The following changes are notified to be made in 1902 :—

Atlantic Station:—The second-class cruiser "Davout" will commission in July to replace the "Suchet," a sister ship, which will return to France in September.

China Station:—The second-class battle-ship "Redoutable" and the second-class cruiser "Descartes" are to return to France, and will be paid off in March.

Indian Station:—The transport aviso "Nièvre," and the gun-boat "Capricorne," will replace respectively the "Rance" and "Scorpion," which are to pay off in May.

Newfoundland and Iceland:—The second-class cruiser "Isly," and the transport aviso "Manche," will commission in April and March for service during the Newfoundland and Icelandic fishery season, and will be paid off in October.

The third-class battle-ship "Bayard" will be put out of commission at Saigon in January.

The "Goéland," will commission in March for the Senegal station.

The "Qui Vive," will commission in May for the Bidassoa.

The "Chimère," will remain in commission from April to November for hydrographical purposes.

The battle-ship "Marceau," will replace the "Magenta" as torpedo-school-ship in June.—*Le Yacht* and *Le Temps*.

ITALY.—*Steam Trials.*—The new first-class battle-ship "Ammiraglio di St. Bon," constructed by the firm of Ansaldo & Co., at Genoa, has successfully completed her steam trials off Spezia. Her dimensions are as follows :—Length, 344 feet 6 inches; beam, 69 feet 4 inches; mean draught, 24 feet 9 inches, with a displacement of 9,800 tons. The engines are twin-screwed triple-expansion, constructed by the builders of the ship from the design of Messrs. Maudslay & Sons, developing 9,000-I.H.P. under natural draught, giving a speed of 16 knots, and 13,500-I.H.P. under forced draught, to give a speed of 18 knots. The normal coal supply is 600 tons, but 1,000 tons can be carried, which will give a radius of action of 4,000 and 7,500 miles at 10 knots speed respectively, and, in addition to the coal, a certain amount of liquid fuel can be carried in the double bottoms. Steam is provided by twelve ordinary cylindrical boilers, which are placed in groups before and abaft the engines, each group being in two compartments, separated by a water-tight bulkhead amidships. The diameter of the cylinders are :—1,118, 1,676, and 2,515 mm. (44. 66, 99 inches) respectively. The contract requires the engines to develop 13,500-I.H.P., with an air pressure not exceeding 40 mm. (1·58 inches), the pressure on the boilers being 155 lbs. on the square inch, and the number of revolutions not to exceed 212. The total heating surface is 2,200 square metres (23,680·5 square feet), with a total grate surface of 78·6 square metres (842 square feet). According to the contract the consumption of coal at the natural-draught trial was not to exceed 900 gr. (32 ozs.) per H.P. per hour. The total weight of the engines with water in the boilers and all the tubes, etc., is 1,340 tons.

The results of the trials were as follows: — Natural draught for six hours :—Number of boilers, twelve: pressure in boilers, 10·54 kg. (23·14 lbs.); pressure at engines, 10·4 kg. (22·9 lbs.); mean air pressure, 8·5 mm. (·3-inch); number of

revolutions, 94·4; I.H.P. developed, 10,407: mean draught, 24 feet 4 inches; displacement, 9,956; mean speed, 17·4; consumption of coal per H.P per hour 850 gr. (30 ozs.). Forced draught one and a half hours:—Number of boilers, twelve; pressure in boilers, 10·56 kg. (23·28 lbs.); pressure at engines, 10·25 kg. (22·59 lbs.); mean air pressure, 32 mm. (1·3 inches); number of revolutions, 104; I.H.P. developed, 14,296; mean draught, 24 feet 3·5 inches; displacement, 9,908; mean speed, 18·3; consumption of coal per H.P., 989 gr. (35 ozs.). The engines worked quite smoothly and satisfactorily throughout, and the trials were considered eminently successful.

At the end of October a competitive steam trial took place between the first-class armoured cruisers "Garibaldi" and "Varese," in order to determine what system of boilers should be supplied to the new battle-ships "Regina Elena" and "Vittorio Emanuele III." The "Garibaldi" is fitted with the Niclausse type of water-tube boiler, and the "Varese" with the Belleville, so in view of the fact that the English Admiralty had decided against the Belleville for their new ships, the trial was looked forward to with lively interest. The "Varese" received orders to steam ahead, and when she was 12 miles ahead of the "Garibaldi" the trial began. The run was for 24 hours, and during that time the revolutions of the engines of the "Garibaldi" were at the rate of from 86 to 88, the I.H.P. developed being 7,000, and the speed 17 knots. Only 16 of the 24 boilers were used, and this was also the case on board the "Varese." The engines and boilers of both ships worked well, the pressure of steam in the boilers being 170 lbs. The consumption of coal in the furnaces of the "Garibaldi" was 6 tons 4 cwt. 35 lbs. per hour, or 1·78 lbs. per H.P. The consumption on board the "Varese" is not stated, but it was rather less. The "Garibaldi" overtook the "Varese" and finished some hundreds of yards ahead of her. The *Italia Militare e Marina* of 5th December states that any judgment with regard to the comparative merit of the two types of boilers is premature, as an accurate examination of all the results of the trials has not yet been made and reported upon. The balance of advantages and disadvantages is about equal in the two types. It is considered proved that the Belleville boilers have a greater working efficiency, and that the Niclausse boilers admit of exceptional facility in partial refitting.

New Ships.—The new first-class battle-ship "Benedetto Brin," was launched on the 7th November last, from the Royal Dockyard at Castellamare, and is a sister ship to the "Regina Margherita," launched at Spezia in the previous May. Her principal dimensions are:—Length, 426 feet 6 inches; beam, 78 feet; draught, 27 feet 4 inches; displacement, 13,426 tons. The two triple-expansion engines, supplied by 28 Belleville water-tube boilers, calculated to develop 19,000-I.H.P. with forced and 16,000-I.H.P. with natural draught, are expected to give a speed between 19 and 20 knots. The extreme coal capacity is 2,000 tons, the bunkers being arranged longitudinally, as an additional protection to the vital parts of the vessel. The hull consists of 5,000 tons of soft steel, wood being entirely excluded. The thickness of the armoured water-line belt, which is 10½ feet deep, varies from 6 to 2 inches, the armour of the barbettes being 8 inches, with 8-inch hoods for the guns, and that of the armoured deck 3 inches to 1·5 inches. Along the water-line, however, the conjunction of the armoured deck with the belt gives a thickness of nearly 9 inches. Above the water-line belt reaching to the upper deck, is a citadel, in which the 6-inch guns are mounted, also protected by 6-inch armour, at each end of which rise the barbettes. The athwartships bulkheads are 12, 10, and 8 inches thick. The armour is of hard steel manufactured at the Terni Works. The principal armament consists of four 12-inch

guns in barbettes situated one forward and one aft; and the secondary armament of four 8-inch guns, mounted singly in turrets, sponsoned out two on each beam, protected by 6-inch armour, twelve 6-inch Q.F. guns, eighteen 3-inch Q.F. guns, and eight 3-pounders, with four machine guns. The vessel is also furnished with four torpedo-tubes, two of which will be submerged. She differs from her sister ship the "Regina Margherita" in having Belleville instead of Niclausse boilers, the number of boilers in each ship being, however, the same, 28. There are, however, only 8 elements in the Belleville boiler, as against 15 in the Niclausse; 128 square metres of grate surface in the Belleville as against 144·5 square metres in the Niclausse; 4,290 square metres of heating surface in the former, as against 4,674 in the latter, while the number of tubes in the Belleville is 3,136, against 7,560 in the Niclausse, the number of furnaces and funnels for both boilers being the same.

The "Benedetto Brin" was laid down in the early part of 1899, and her launching weight was 7,000 tons.

Progress is being made with the new first-class battle-ship "Regina Elena," which has lately been laid down at Spezia. She will differ considerably from other vessels of her class in the composition and disposition of her artillery. She will carry two 12-inch guns in her fore and aft turrets, and twelve 6-inch guns in six turrets on her broadsides, arranged at two different heights, so that she will be able to fire one 12-inch and eight 6-inch guns either fore or aft: her broadside delivery being from two 12-inch and six 6-inch guns. She will also carry twelve 3-inch guns. Her engines will develop 19,000-H.P., and give her a speed of over 20 knots. A commencement has also been made with the "Vittorio Emanuele III.," of the same type, which has been laid down at Castellamare.

Two new steam colliers are to be built by contract for fleet purposes.

Report on the Candidates for Entry to the Naval School.—According to the medical report on the candidates for entry to the Naval School in 1901, it appears there were 105, between the ages of fifteen and nineteen years. Of these forty-eight passed, fifty-seven being rejected. It appears that the central provinces provided the largest percentage, 57 per cent., of all the successful candidates, the northern provinces came next with 47 per cent., and the southern provinces with only 37. In accordance with the latest regulations, issued last January, the medical examination is now a very stringent one, no candidate with any imperfections however trifling being now allowed to pass.

A New Dockyard.—The "Officine e Cantieri Liguri-Anconetani" Company has taken over the old arsenal of Ancona, from the Chamber of Commerce and Municipality, and is enlarging and bringing it up to date. Up to a short time ago only 180 men were employed in the yard, now there are over 1,500. Four new ships have been built, which are now all occupied, on one a steamer of 6,000 tons is being constructed, while a large floating dock to carry a vessel of 5,000 tons displacement is under construction. There is great need for this, as the only other docks on this east coast are those at Venice. The company is fast reviving the traditions of the old sea-port. Originally the Papal Arsenal, it was used for some years for the Italian Navy, but when the dockyard at Venice was enlarged the yard at Ancona was dismantled. The first steamer to be built at the newly constituted yard was launched on the 11th November last, and is a vessel of 4,000 tons, and the occasion was made one of some ceremony, the Minister of Commerce being present.

The harbour of Villa San Giovanni in the Straits of Messina has been constituted a war port from the 1st July. A credit for the necessary works has been placed on the

Extraordinary Budget, amounting to 1,600,000 lire (£64,000), which is to be spread over four years.

The Ansaldo Firm.—An interesting pamphlet has lately been published by the great Ansaldo firm of Leghorn, giving a history of the development and growth of this the greatest industrial undertaking in Italy, and a full description of its present yards and works.

The company was first formed in the year 1846, and received warm support from Count Cavour, who, as is well known, played a leading part in calling into life home industries, with the express purpose of making Italy independent of foreign supplies.

In 1900 the Ansaldo firm had acquired and were working the following industrial establishments :—The Sampierdarena Factories for the construction of locomotives and marine engines: the dockyard at Sestri Ponente for the building of war and merchant ships: the Cornigliano Metal Works; the Cornigliano Iron Foundries and Steel Works; the Cornigliano Electrical-Machine Factories; the repairing yards for war-ships at Genoa (Molo Giano and Molo Vecchio). These different establishments cover a space of 290,000 square yards: the engines for working the machinery develop 2,000-I.H.P., and some 16,000 workmen find employment in them. The Sampierdarena factories turn out yearly 200 locomotives, ship's engines developing 100,000-H.P., 2,000 tons of boilers, and over 1,000 tons of iron and steel work. In the last two years machinery to a total H.P. of 200,000 have been supplied to foreign Navies, 45,000-H.P. for merchant-ships, and 400 locomotives.

Between 1887 and 1900, 33,800 tonnage of war-ships, and 82,300 of merchant-ships were launched. Although the different establishments are in constant communication, yet they are all independent of each other, so there is greater freedom and a more rapid carrying out of work. How good the results are is shown by the fact that both the Argentine armoured cruisers "Garibaldi" and "Pueyrredon" were ready for their trials six months after launching.

A new factory for the construction of submarine mines, under-water torpedo-discharges, etc., has lately been added.—*Revue Maritime* and *Marine-Rundschau.*

THE ITALIAN NAVY.—A VISIT TO SPEZZIA BY M. LOCKROY.

TRANSLATED AND ABRIDGED FROM "LE TEMPS."

Young nations possess this considerable advantage, that they are not hampered by the traditions of the past, and are able to profit by the experiences of their elders. This was the position of Italy when she started to create a Navy. She had a free and open field and profited by it in the most marvellous manner.

The arsenal at Spezzia is admirable, it has been possible to combine in it everything required by the exigencies of modern science and machinery. In the disposition of the arrangement and, above all, in the scrupulous cleanliness and order of the whole, one can recognise German influences; but whereas Germany has no end in view but utility, Italy to this has added magnificence. The roads of the arsenal bordered with fine trees remind one of the avenues of a royal demesne, the workshops and stores have the appearance of palaces: one feels oneself in the country of Michael Angelo: never, I should think, has a Navy been more sumptuously provided for.

Spezzia, besides, is one of the finest ports of the Mediterranean; the immense harbour, like a cup in form, opens widely to the sea, but a breakwater joist or wash shuts in and protects it, traced only by the line of white foam which the waves make

breaking over it. Two passages are open at the ends to allow of the entry and egress of vessels: on the right pictures que green heights, dotted with rocky patches, extend as far as the little port of Porto-Venere, which for so many years was contended for by the Pisans and Genoese: to the left are high mountains, on the slopes of which the workings of the Carara marble quarries show up as long white seams: further off still are the snow-covered summits of the Appenines. The sea front of the town is laid out in a fine promenade, planted with palm trees, and the water is so calm and deep that the largest battle-ships can moor to buoys quite close to the shore.

The harbour is, so to speak, a dependency of the arsenal, and in each of its creeks or bays some department of the arsenal has been accommodated. Here, stores for torpedoes: there, a place for regulating and running torpedoes: there again an experimental gun trial ground or a powder magazine.

The dockyard itself is quite separated from the town, and naval officers congratulate themselves on this arrangement. A wide and deep canal completely surrounds it, like the water-moat of an old fortress, which can be crossed only by wooden bridges, besides protecting the arsenal from workmen or others who might attempt to steal Government stores by throwing them over the wall, the canal also forms a convenient mooring place for lighters and other small vessels which would otherwise encumber the military port.

It is impossible for me to describe with what kindness I was received by the naval authorities or the courtesy of the Minister of Marine in allowing me to visit the arsenal and any of the vessels building or in port. Admiral Marchese was good enough to accompany me when crossing the harbour to visit the different establishments, together with the heads of the departments, and these gentlemen were kind enough to reply to all my questions and requests for information with the greatest courtesy and patience.

The Italian Navy at the present time possesses a highly trained and capable body of officers, one thing only they themselves regret that they have not sufficient opportunities of practising their profession at sea: it is a question of money, coal is expensive, and keeping the fleet at sea is costly, and Italy is economical.

Following the example of France, Italy has organised an "*inscription maritime*" round her coasts: many of her officers regret this step; they say that if it furnishes them with a sufficiency of seamen, it does not provide enough machines. The Navy is becoming more and more complicated, and modern vessels are floating masses of machinery. The most important man of the crew formerly was the able seamen, now it is the mechanic, the *personnel* of the "*inscription maritime*" is not rich in "specialities," and the men for the greater part are quite ignorant of machinery, it is therefore necessary to educate them up to this, and when the education is completed they leave the Service, it is a question in Italy whether the German system is not the best, which enroles, besides men of the sea-coast population, workmen employed in the great industries, such as firemen, mechanics, and electricians. It is true that these have to be transformed into sailors, but it is easier to accustom a man to a life at sea than to teach him to work an engine or stoke a boiler.

Spezzia is formidably defended, all the surrounding heights bristle with batteries, naturally the admiral maritime prefect is in sole command, all the troops being under his orders. Italy, listening to the advice of M. von Moltke and Gambetta, which we shut our ears to in France, has confided the defence of her arsenals and coasts to the Navy. At Rome, as at Berlin, the view has been that a struggle between sea and land forces is only a form of naval combat which seamen alone are apt to direct, and in Italy this organisation has besides the advantage that it gives employment to those men

the "*inscription maritime*" who in time of war would not be incorporated in the Army, and who for want of room could not be embarked in the fleet.

Spezzia is the most important, one might almost say the sole, arsenal of Italy.

La Maddalena is only a strategic *point d'appui*, Naples wants more space and room, Taranto is only half finished, and Venice is curtailed and circumscribed by the old arrangements of the Doges. At Spezzia, therefore, all the most important adjuncts of the Navy are concentrated: among the most interesting of these must be mentioned the Experimental Dock. I had seen something similar at Bremerhaven, but nothing to compare with the Italian installation, which is perfect. It is designed as a means of studying the form and underwater lines to be given to a new ship, also the resistance, form of propeller, and in fact all such problems as are connected with naval architecture. The appliances consist of a large melting boiler for melting parafine, plaster moulds into which the parafine is run, and an ingenious and complicated machine which gives to the parafine model the exact form of the ship, the design of which is under trial. Finally, a canal of filtered water 150 metres long (492 feet) and about 6 metres wide (19·5 feet), above which travels an electric car to which is attached the parafine model. After a few runs on the canal with these appliances, a mathematically exact idea of the qualities and defects of the proposed vessel is arrived at, and many errors and faults often irreparable are thus avoided and obscure questions are cleared up. A great Minister of Marine, Brin, enriched the arsenal at Spezzia with this Experimental Dock, and I have never seen a better or more perfect installation. All the appliances and the models, 4 or 5 metres long, are arranged in a long gallery at one end of the canal, and there is abundance of light and air. Among the profiles of ships arranged along the walls, I remarked those of several Austrian vessels which have been built at the fine arsenal at Pola. The great advantages of the Experimental Dock are so evident, that profiting by the treaty which unites the Triple Alliance, Austria submits all her designs experimentally to Spezzia. There are similar installations in the United States, Germany, and England. France alone has nothing of the sort. When I endeavoured to get an Experimental Dock established, I met with insuperable obstacles, and it was not without a feeling of sadness that I admired this work of Brin.

The "Regina Margherita," under construction at Spezzia, is a fine battle-ship of 13,426 tons: in her is represented the Italian policy of sacrificing the defensive to the offensive: every endeavour has been made to attain the greatest speed possible and curtail weight, and in the "Regina Margherita" the belt has been fixed at a thickness of 15-centimetre (5·9-inch) in opposition to the 30-centimetre (11·8-inch) and 35-centimetre (13·7-inch) armour of our own battle-ships, it being thought that the belt would be rarely struck, and that even if it should be hit it is not always penetrated. In the centre of the ship is an armoured redoubt to protect the guns, which comprise twelve 15-centimetre (5·9-inch), four 20-centimetre (7·8-inch), four 30-centimetre (11·8-inch), and sixteen 76-millimetre (2·8-inch) guns, the latter being disposed about the ship in various positions. If the "Regina Margherita" mounts two guns less than our 15,000-ton ships she posseses four 20-centimetre (7·8-inch) guns of a superior calibre and she can steam 20·5 knots, whereas our battle-ships have only a speed of 18 knots. On the whole, she is a remarkable ship, with fine handsome lines, recalling one of the best of the conceptions of Brin.

Formerly, Italy had a passion for enormous guns—the famous 100-ton guns. These are no longer placed on her new ships, but still are made use of for the defence of the arsenal, being mounted on floating pontoons fitted with hydraulic loading and training gear. These pontoons are low in the water and are towed out into the bay for target practice; sheltered in the inlets or posted behind the breakwater, they would be formidable adversaries for an attacking fleet.

On the other side of the bay, near San Bartolomeo, are the torpedo establishment, including the torpedo school and store and the range for trial and adjustments; separated from the arsenal the torpedo *personnel* are here by themselves; the above is superb. 40 metres long, with seven double rows of torpedoes on high staging; the position for trying torpedoes is well placed in a handsome building at the end of a pier. Italy uses both the bronze German torpedoes of Schwarzkopff and the steel Whitehead torpedo; the latter seems to be preferred by the Italians, who have more confidence in the steel than in the bronze.

As regards submarine boats, the Italians possess a trial boat called the "Delphin," which I was shown; the young officer in command appears to have perfect confidence in his vessel, but she is still in the experimental stage.

The Italian Navy is most painstaking, interested in the progress of other Navies, and anxious to distinguish itself in war. I have already mentioned its weak point—want of money. Italy has not a budget in accordance with her ambitions; the forced economy of the Chambers and the Ministers has often imposed on the Navy painful restrictions, which have been patriotically and bravely endured. King Humbert was supposed to treat the Navy with coolness, King Victor Immanuel III. loves it and interests himself in its progress: ladies of high rank embroider the flags which are presented to the captains of the ships, the presentation of these colours being always made a grave and solemn ceremony. Italy has many accomplished writers on maritime subjects, such as Vecchi, the author of the "History of the Navy"; and she has gallant and eloquent seamen, such as Admiral Bettolo; and she has, above all, to raise the enthusiasm of the nation, the immortal examples of the past. The memory of Rome and the glory of bygone days seem a gauge of the glory of the future.

RUSSIA.—*The New first-class Battle-ship "Retvizan."*—The first-class Russian battle-ship "Retvizan" possesses special interest because of the fact that she is the first important foreign battle-ship to be constructed in an American shipyard. The first foreign orders for war-ships of the modern type were those given by the Japanese Government to the Union Iron Works of San Francisco and the Cramp Shipbuilding Company of Philadelphia, for two high-speed cruisers. Both of these vessels have been built and delivered, and each of them considerably exceeded the contract speed. Following closely upon the trials of these vessels an order was placed by the Russian Government at the Cramps' yard for the construction of a battle-ship and cruiser. The latter, the first-class cruiser "Varyag," had her trials last year and achieved a speed of more than 23 knots an hour, thus taking rank as one of the very fastest vessels of her kind in the world. The battle-ship has recently undergone her builders' trial, on which she attained an average speed on a 12 hours' trial of 18·8 knots per hour.

The "Retvizan," as she is called, is a first-class battle-ship of 12,700 tons displacement. In size and speed she may be compared with our own vessels of the "Maine" class, as is done in the table below:—

	"Maine."	"Retvizan."
Length	388 feet	374 feet
Beam	72 feet 2½ inches	72 feet 2 inches
Draught	22 feet 6 "	25 feet
Displacement	12,300 tons	12,700 tons
Battery	four 12-inch	four 12-inch
	sixteen 6- "	twelve 6- "
	six 3- "	twenty 3- "
	eight 6-pounders	twenty 3-pounders
	ten small calibre	six 1- "

The "Retvizan" is protected by a belt of armour 9 inches in thickness which extends from 4 feet below the water-line to 3 feet above, reaching to the level of the protective deck. The latter is 2 inches in thickness on the flat and 4 inches on the slopes. It commences to slope at the level of the top of the 9-inch belt, and descends to a junction with the bottom of the belt below the water-line. The space between the slope and belt is occupied by coal bunkers. A projectile, before penetrating the engine or boiler rooms, would consequently have to penetrate 9 inches of Krupp steel, from 6 to 10 feet of coal, and 4 inches of sloping Krupp armour. The coal would equal in resistance about 3 inches of vertical steel, and the 4-inch slope would be equivalent to 6 inches of steel, thus giving a total resistance equal to a vertical belt of 18 inches of steel, which is the thickness carried by our vessels of the "Oregon" class. In reality this triple protection would be equal to more than 18 inches of solid steel, for the reason that two successive face-hardened surfaces would have to be broken through, a test which would, unquestionably, break up any projectile that exists. The protective deck is carried the full length of the vessel, and curves down to meet the stem and stern. At the stem it is merged into the framing of the ram-bow, and being 3 inches in thickness and of turtle-back form, it gives enormous stiffness to the ram, and would assist in transmitting the shock of ramming to the whole structure of the vessel. Above the 9-inch belt amidships, and between the protective and the gun decks, is worked another belt of armour, 6 inches in thickness. This will prevent rapid-fire shells from penetrating and bursting beneath the guns on the gun-deck above.

The bulk of the rapid-fire armament is carried on the gun-deck. Amidship, above the 6-inch belt of armour above referred to, is a battery of eight 6-inch rapid-fire guns in casemates, each gun having a considerable train forward and aft. The casemates are protected by 5 inches of steel and the armour is carried athwartships at each end of the battery as a safeguard against raking fire. The 9-inch and 6-inch belts of armour are also carried athwartships to connect with the armour of the barbettes, thus forming a completely enclosed armoured citadel amidships. At the four corners of the superstructure deck, above the central citadel, are four 6-inch rapid-fire guns, of which the forward pair can be trained dead ahead and the other two dead astern. These guns are protected in front with 5 inches of steel, and they are enclosed in the rear with a wall of 2-inch steel, thus forming a completely enclosed casemate.

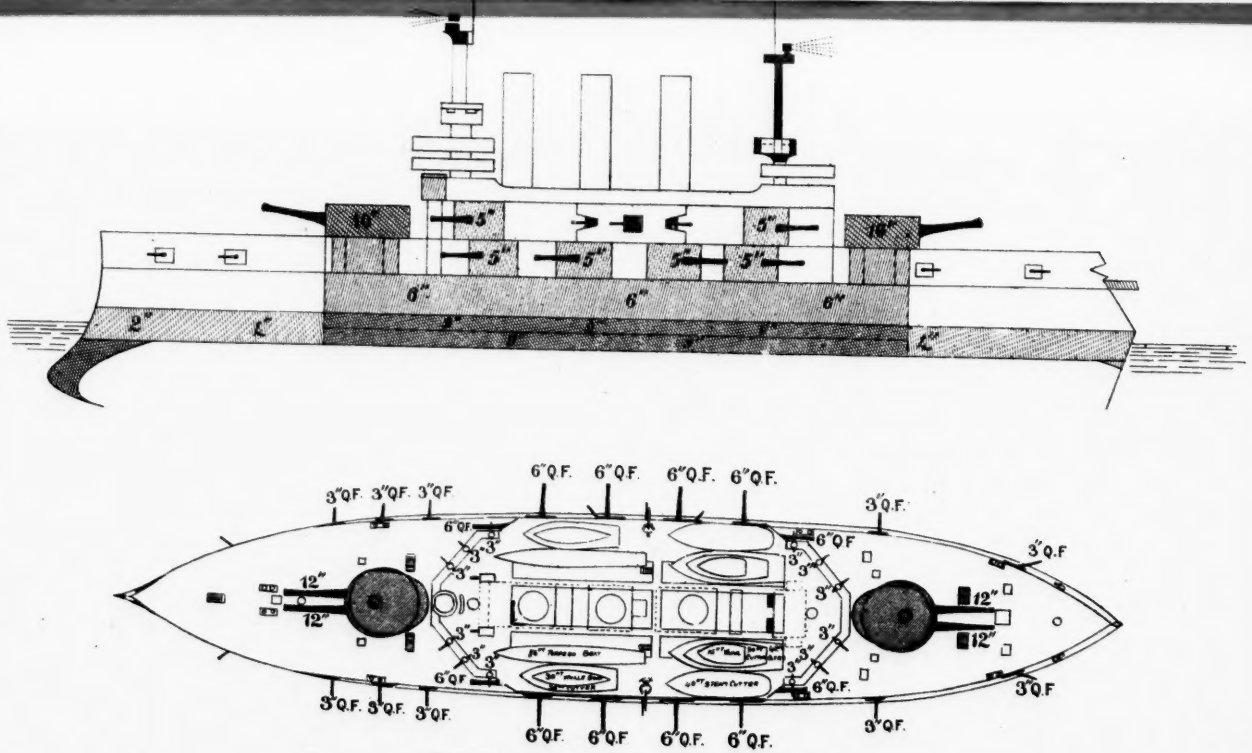
Forward of the central battery on the gun-deck are four 3-inch rapid-fire guns, each with a protection of 2 or 3 inches of casemate armour, while aft of the battery are six rapid-fire guns of the same calibre. The upper or main deck is flush throughout the ship, and is broken only by the amidship superstructure. Forward and aft of the superstructure are two elliptical balanced turrets, armoured with 10 inches of Krupp steel. In each turret are placed two 12-inch 40-calibre breech-loading rifles of the standard type manufactured by the Russian Government. Both the turrets and the guns are operated electrically. An interior view of these turrets impresses one with the fact that the manipulating gear of both the guns and turrets is of a compact and serviceable design. There is an absence of complication and an abundance of working space for the guns' crews. The guns are mounted very close to the roof of the turrets, according to the regular Russian practice, and the roof itself, which is of 3-inch Krupp steel, is slightly curved to clear the muzzles of the guns when the latter are elevated or depressed.

The battery, as it stands, is a numerous and powerful one, but the Russians, even more than ourselves, believe in a multiplication of guns, and outside of the twelve 6-inch and 3-inch rapid-firers, above mentioned, there are twenty-six smaller guns,

which are mounted on the boat-deck, the bridge, and the fighting-tops. Forward and aft on the boat-deck there are distributed twelve 3-inch rapid-firers, while on the forward and after bridges, immediately above these, are eight others of the same calibre. These guns have a range of fire from dead ahead to abeam. There are also six 1-pounders in the two fighting-tops. With such a numerous rapid-fire battery, a specially large supply of ammunition has to be carried, 2,400 rounds being supplied for the 6-inch guns alone. 308 rounds are carried for the 12-inch guns, which is considerably above the number of rounds ordinarily carried in modern battle-ships for the main battery. Special provision is made for the supply of ammunition, electric hoists being installed throughout the ship.

The vessel is driven by triple-expansion engines, and steam is supplied by Niclausse water-tube boilers of a combined capacity of 16,000-H.P. The normal supply of coal is 1,016 tons, but it is possible to stow 2,000 tons aboard if so desired. As compared with our battle-ship "Maine," it will be seen that the main battery is not so powerful, our vessel, which is about the same displacement, carrying sixteen as against twelve 6-inch rapid-fire guns. This, however, is somewhat offset by the larger number of 3-inch rapid-firers installed on the "Retvizan." The Russian Government is so secretive in all matters affecting its naval department, that very little is known to the public about the present state of its ordnance. The guns, both 12-inch and 6-inch, appear to possess features in common with both the Canet and the Krupp types, although modifications have been introduced in accordance with Russian ideas. The 6-inch rapid-fire guns are of 45 calibres, or 5 calibres less than our new 6-inch guns. It is believed that the Russians, like the Germans, favour a heavier projectile and lower initial velocities than we do, having in view the consequent gain in remaining velocities, and greater penetrative ability at long range. Compared with our 6-inch naval gun, recently illustrated in the *Scientific American*, the Russian piece is considerably more complicated. The recoil and return to battery are controlled by a combination of glycerine cylinders and recoil springs. These springs, of which there are four, are located in the open on each side of the recoil cylinders, and certainly detract from the appearance of the piece, besides rendering it more liable to disablement by flying fragments of shell. The breech mechanism, moreover, is considerably more complicated than the modified Welin breech mechanism which was recently adopted by our Navy.

The "Retvizan," taken altogether, is unquestionably an exceedingly fine representative of the up-to-date first-class battle-ship. She has high speed, large fuel capacity (for it should be mentioned that her double bottom is to be utilised for carrying a certain amount of liquid fuel); the battery is numerous and thoroughly modern; while the ship itself has a high freeboard, and is remarkably free from those towering superstructures which disfigure many modern battle-ships, especially in the French Navy. On going through the vessel we were impressed with the fact that inflammable material was practically non-existent. The decks are of steel and the partitions are of the same material, as are the shelves, boxes, and general furniture. The Messrs. Cramp are to be congratulated on having turned out such a thoroughly handsome and effective vessel.—*Scientific American.*



PROFILE AND DECK PLAN OF "RETVIZAN."

MILITARY NOTES.

PRINCIPAL APPOINTMENTS AND PROMOTIONS FOR DECEMBER, 1901.

Major-General L. J. Oliphant, M.V.O., to be Major-General on the Staff, Field Force, South Africa. Lieut.-Colonel H. C. Rice, A.S.C., to be Colonel. Colonel L. R. H. D. Campbell, I.S.C., to command a Second-Class District in India and to have the temporary rank of Brigadier-General whilst so employed. Lieut.-Colonel and Brevet Colonel A. R. Porter, I.S.C., to be an A.A.G. in India and to have the substantive rank of Colonel in the Army whilst so employed. Brevet Lieut.-Colonel F. J. Aylmer, V.C., from Major R.E. to be an A.Q.M.G. in India, and to have the substantive rank of Colonel in the Army. Lieut.-Colonel C. H. Law, C.B., the Dorsetshire Regiment, to be Colonel. Lieut.-Colonel A. R. Pemberton, the Rifle Brigade (the Prince Consort's Own), to be Colonel. Major and Brevet Lieut.-Colonel J. R. L. Macdonald, C.I.E., R.E., to be Colonel in recognition of his services during the operations in China. Surgeon-General W. Taylor, M.D., C.B., Hon. Physician to the King, to be Director-General of the Army Medical Service. Major-General Sir B. Blood, K.C.B., R.E., is appointed to the Staff in India, graded as a Lieut.-General, with the local rank of Lieut.-General whilst so employed. Brevet Colonel J. M. Grierson, M.V.O., from Major R.A., to be an A.Q.M.G., and to have the substantive rank of Colonel in the Army. Colonel W. T. Shone, C.B., D.S.O., is granted the temporary rank of Major-General whilst employed as Director-General of Military Works in India. Lieut.-Colonel G. W. H. Pain, C.B., the Worcestershire Regiment, to be Colonel. H.R.H. George F. E. A., Prince of Wales and Duke of Cornwall and York, K.G., K.T., K.P., G.C.M.G., G.C.V.O., Colonel-in-Chief of the Royal Fusiliers (City of London Regiment) and Royal Marines, to be Colonel-in-Chief of the Royal Welsh Fusiliers. Brevet Colonel B. A. Satterthwaite from Lieut.-Colonel the Loyal North Lancashire Regiment to be Colonel to command the 30th (the East Lancashire Regiment) and the 47th (the Loyal North Lancashire Regiment) Regimental Districts. Lieut.-Colonel E. W. Cotter, R.E., to be Colonel. Lieut.-Colonel W. L. C. Baddeley, R.E., to be Colonel. Colonel J. M. Babbington is granted the local rank of Major-General whilst employed as Commandant of the New Zealand Forces.

HOME.—At the recent meeting of the British Association Professor, George Forbes read a paper on "A Folding Range-Finder for Infantry." The author stated that the instrument shown belongs to the class known as a "one-man portable-base range-finder." It possessed great accuracy up to 3,000 yards. It is founded upon the original idea of Adie, whose instrument was liable to errors. Barr and Stroud, of Glasgow, and Zeiss, of Germany, have brought range-finders with short bases to great perfection, as they could give all the accuracy required. Our Navy is fortunate in being supplied with the Barr and Stroud instrument. The mekometer is the instrument now used by our infantry, and it has done admirable work: but a one-man instrument which allows the observer to be under cover, and which is applicable to moving objects, is needed. It must be of

good form, convenient to handle, and extremely portable in shape, length, and weight. It should be usable without a stand, and the magnifying power of its telescope should certainly not exceed 12 diameters. It should have an accuracy so great that even at 3,000 yards there should be no possibility of an error exceeding 2 per cent. in the hands of an average man. Its use should be attainable after a short training by an average man not accustomed to optical instruments. It should not require too much care, and should even be able to stand moderately rough usage. It is desirable that if it ever gets out of adjustment, the fact should be immediately apparent. It should work well on badly-lighted objects and those affected by mirage. These conditions are based upon the War Office specification, and the instrument shown at the meeting embodied the inventor's desire to meet them. The instrument consists of a folding aluminium base, 6 feet in length, and a field glass. The base is a square tube hinged at its middle part. Each part of the base has at each end a doubly reflecting prism. The rays of light from a distant object strike the outer pair of these four prisms, are reflected at right angles along each tube, and are then reflected at the two middle prisms into the two telescopes of the binocular fixed to the base in directions parallel to the original rays intercepted by the outer prisms. It is the measurement of the angle between these rays that tells the distance of the object looked at. This angle is measured by two vertical wires, one in each telescope, seen by the two eyes. One of the wires is fixed and the other is moved by a micrometer screw until the two wires appear as one, and the object is seen distinctly. This gave the distance accurately to 2 per cent. at 3,000 yards. But stereoscopic vision gives far greater accuracy. The wire seems to stand out solid in space, and the slightest turn of the screw causes the wire to appear to be nearer or farther than the object looked at, and when the wire appears to be exactly the same distance, the micrometer reading gives the distance with an accuracy far greater than that attained by observing the duplication of images on the retina. The author proceeded to refer at greater length to the accuracy of stereoscopic vision. Dr. Wolf, of Heidelberg, had a stereoscopic comparator for detecting the motion of the stars from photographs taken at different dates. With this instrument the author had observed the movement of some of the stars at right angles to the sun's motion by means of two photographs taken at intervals of four years. The nearer stars appear with this gigantic base to stand out distinctly nearer than the others in the stereoscope, although no micrometer with the same magnifying power could detect the parallax. The base weighs 3 lbs., and the binocular weighs 1 lb., and magnifies twelve times.

The discussion on Professor Forbes' paper was opened by Professor Stroud, who said that he and Professor Barr had been engaged for a long time on range-finders, but had not succeeded in getting an instrument so light and portable as the one shown. Their instrument was larger and more accurate. He did not consider the range-finder described would be useful for marine work. He thought that coincidence adjustment would be more accurate than stereoscopic adjustment.

Professor Barr joined with his partner in congratulating the author upon his paper. It was unfortunate that it was impossible to discuss the matter without comparing the range-finder which was the subject of the paper with the instrument he and his partner had introduced. The latter was the only one of the same kind which had preceded the present form, and, therefore, comparison was inevitable. At the present time almost every large ship in the Navy had two of the Barr and Stroud instruments, and over 400 had been supplied. He did not agree, as had been stated, that the success of their range-finder was due to accuracy of workmanship. A good

engineer endeavoured to devise a machine which should not need extreme accuracy for success. The defect of the range-finder described by the author was its very small field. The centre of the object might be clearly defined, but the other parts would have less light in the image. The military authorities very much wished for an instrument that could be used as a telescope to pick up an object. He would also prefer prisms so as not to need silvered surfaces. He did not agree that binocular vision was so accurate as the method of single coincidence. In the Barr and Stroud finder one eye was on the object and the other on the scale.

Dr. Henderson referred to the error of 2 per cent. at 3,000 yards, mentioned by the author, and considered that some error had been made in the calculation.

Colonel Crompton said that having lately been engaged in South Africa, where he had to place the largest guns yet used in the field, he had had some experience in the need of range-finders. The supply was contemptible, and they invariably found themselves without the necessary equipment in this respect. It was usual for the artillery officer to take a bicycle and ride across country, carrying a theodolite, and in this way the district was portioned out and definite ranges plotted on a map. The reason of the breakdown in the equipment was afterwards known. It is the Service custom to place a range-finder on the end guns of a battery only. When the big guns were sent to the front, this usual rule was followed, although they were only to be used singly He had made experiments himself some years ago when he was in the Army, and could bear witness to the accuracy of stereoscopic vision. One of the requirements of a range-finder was that it should not be affected by mirage. It was often easy enough to get the range from hill-top to hill-top; but when the observation had to be made over a mountain side, it was often impossible to lay the gun or to point rifles. The extreme range of the modern rifle was about 2,000 yards. At the outer end of the range it was more important to secure accuracy than at the nearer positions, because at the first part the trajectory was flat, but towards the end the bullet drops rapidly.

Professor Forbes, in reply, said he was glad that Messrs. Barr and Stroud were working on different lines. Their instrument was admirably fitted for use on board ship, but he would not advise the one described in the paper for marine work. In regard to what had been said about the size of the field and the reflecting prisms, he could only say there were many things that might have been altered or added to with advantage: but he had to work to a specification framed to meet certain general conditions.—*Engineering.*

GERMANY.—The following information is extracted from the draft of the Prussian War Budget for 1902. In the chapter on the "Permanent expenses of the ordinary budget" there appears a sum of 35,700 marks to be devoted to the formation of two new artillery brigade-division commands, and of three posts for officers fulfilling the duties of advisory reporters: an increase of 456,760 marks for the staff and for the survey of the country; an increase of 1,257,434 marks for the pay of troops, in consequence of the scheme for the formation of 7 new machine gun battery groups, to augment the 5 groups already existing and for the formation of 10 new companies of foot artillery.

The 1902 Budget also provides for the creation of 5 battalion commanders, 20 captains, and 200 lieutenants, 184 of whom will be attached to the higher commands as orderly officers. On the other hand, 184 billets for sub-lieutenants are to be abolished, but as 45 additional sub-lieutenants are required for the new formations mentioned above, the actual number of these billets to be abolished will only amount

to 139. An increase of 2,144,385 marks is allotted for supplies; there is also an increase of 374,735 marks provided for the purchase of remounts.

The chapter on artillery *matériel* and arms shows an increase of 527,435 marks. The total amount of permanent expenditure amounts to 443,281,516 marks, or an increase of 8,106,726 marks over that of 1901.

Amongst the items in the chapter devoted to "Expenditure of the ordinary budget paid once," are found: a first annuity of 500,000 marks for railway bridges; a first annuity of 20,000 marks for the new Kaiser Wilhelm Academy meant for the instruction of military doctors at Berlin; a first annuity of 15,000 marks for the new Military Technical Higher School at Charlottenburg, etc.

In the chapter "Extraordinary expenditure of the budget paid once" may be found: a sum of 500,000 marks for the purchase of railway *matériel*; 4,728,000 marks for the construction of fortified works; 800,000 marks for the strengthening of certain fortifications, etc.

In the preamble, with regard to the formation of new machine gun battery groups, the following passage occurs:—"The trials pursued with regard to machine guns have amply confirmed all the reports on the immense value of this new arm; they have proved at the same time, that the effective both of *personnel* and horses hitherto given to these groups is not sufficient to allow them their proper efficiency under all circumstances. An increase in the effective of the already existing 5 groups is therefore necessary."

As regards the formation of the 10 new foot artillery companies, it is remarked in the preamble:—"The duty of this arm in future warfare has become far more difficult. The existing battalions are not sufficiently numerous to constitute attack formations, when it is necessary at the same time to have excellent artillery troops along the frontier, who would form there the nucleus of the defence. In order to complete our defensive system fortified works have been constructed, for the occupation of which we have not sufficient artillery. . . . It is intended to attach these 10 companies, in groups of two, to the already existing foot artillery battalions. Three of these groups of two companies each will respectively garrison Fort Boyen, Thionville, and Marienburg."

The formation of a Military Technical High School is thus explained:—"The duties of Engineers in modern warfare impose on the Army a higher development of technical science which plays an important part in modern military requirements. In the present instance the subjects dealt with are steam, electricity, mechanics, the construction of roads and bridges, means of communication, etc. It is not possible to give an adequate scope for technical sciences in the curriculum of study at the War Academy." The object of the Military Technical High School is to advance technical knowledge in the Army, to give a more special instruction to officers of the communication troops and to technical institutions, as well as to officers who wish to prepare themselves for admission to the Corps of Engineers. This High School will receive 200 officers and will be open on the 1st October, 1902.—*Revue de Cercle Militaire.*

An article, under the title "*Les tendances nouvelles de l'Armée Allemande*," has appeared in a recent number of the *Revue des Deux Mondes*, which has excited much attention abroad, especially in Russia, where it has been translated by General Pouzyrevsky, of the Varsovie District. An article on the same subject, which appeared in the *Rouskii Invalid*, ends with the following conclusions:—

1. On account of the rapidity of mobilisation, the long range of guns, smokeless powder, and of masses of cavalry forming a screen, it will be exceedingly difficult to guess the dispositions and the intentions of the enemy, and consequently to direct one's reserves, in sufficient time, to where they will be necessary. To avoid this difficulty, the best plan is to take the initiative oneself in order to force the enemy to throw light on the situation. From this arises the incessant propaganda of German military writers in favour of the *offensive at all costs.*

2. Full use should be made of the range and rapidity of fire of fire-arms. For this purpose it becomes necessary to place in line the largest proportion possible of the fighting force and consequently to considerably increase the length of frontage hitherto thought sufficient. Thus, company and battalion reserves will only exist at the commencement of an action, and will disappear progressively and entirely into the line of skirmishers before the enemy is clearly seen.

3. Thanks to the rapidity of artillery and infantry fire, the results of that fire will be very promptly obtained, and consequently reserves, keeping themselves at a distance in the rear of the fighting line, will have have no time to intervene in the action. The battle will, therefore, be carried out by divisions, formed into a line of skirmishers, regimental and divisional reserves; there will no longer be any army corps or army reserves. The army, in the contact zone with the enemy, will advance, for the greater part of the time, across country in line of division or brigade columns. In those areas where formerly army corps or army reserves were placed, the division columns will be brought closer together to concentrate the fire of guns and rifles. The effect produced is the same as if the intervals of the fighting line had been reinforced by units which formerly constituted the army corps and army reserves.

4. The *rôle* of these former army corps and army reserves will in future be played by those divisions which, in accidental encounters, such as will most probably take place in future, are furthest from the field of battle and can strike to no purpose . . . . . Army and army corps commanders should direct them in their column formation and should keep them for enveloping or turning movements or to pierce the enemy's line. Or commanders of these divisions themselves, acting on their own initiative, will march to the sound of the guns, and, preceding their troops, will reconnoitre the situation in order to intervene at, where they consider, the most favourable spot. Divisions opposed by an enemy in superior strength will remain, provisionally, on the defensive. Instead of reinforcements, ammunition will be sent them in order that they may be able to increase the intensity of their fire.

5. Masses of cavalry will also occasionally make up for the deficiency of army corps and army reserves. They may be kept screened from fire and hurled rapidly to the front at the decisive moment.

6. This process will often be most advantageous and may result in brilliant victories. As a rule fierce fire is generally immediately followed by a bayonet attack because the enormous expenditure of ammunition does not allow of a prolonged fire, and a pause between the fire and the attack is not advantageous. The reserves which deliver the attack should, therefore, be close up. The Germans themselves recognise the danger of such head-long attacks, but they consider that the excellent composition of their corps of general officers, who have been carefully trained to take the initiative, gives them the right to hope that they will only carry out such charges when they think they have every chance of success.

7. The defensive will always partake of an active character, and in that case will probably always have strong reserves.

8. There is nothing new on the subject of strategic reserves; there is, therefore, every reason to believe that in future every available man will be brought on to the battle-field.

Such are the conclusions drawn by the author of the article in the *Rouskii Invalid* from his study of German manœuvres and German authors. The question summed up is as follows :—

The efficacy of fire and the depth of columns oblige the reserves to be kept well in the rear. On the other hand, owing to the rapidity and efficacy of fire, the attack develops raddily, and therefore the reserves must be quite close up. To reconcile these two extremes the Germans place all their reserves at once into the firing line and try to mass their cavalry in close proximity. By arming the latter with an automatic revolver they will be able to increase their power, because they will fire from horse-back. However that may be, the Germans rely, above all, on the qualities of their superior commanders, whom they judge superior to those of their neighbours, and on their qualities of initiative and of pressing the offensive to the uttermost possible limits.—*La France Militaire.*

RUSSIA.—The Emperor has recently approved of a new regulation regarding the leave of absence to be granted to officers. It is of special importance for regimental officers, who have hitherto found very great difficulty in obtaining leave in spring and summer owing to their duties in camps and at manœuvres. The rules for leave of absence for officers are now, since the 19th December last, as follows:—

1. Leave of absence for twenty-eight days and less, which officers may be granted each year, remains as formerly, without limitation, and is generally given for family or urgent affairs.

2. Leave for two months with pay, which was only given every second year, may be granted each year to officers and functionaries holding rank at least equal to that of first captain. Officers and functionaries of lower rank have only the right, as formerly, to two months' leave on full pay once every two years.

3. Officers, who have need of longer leave on account of ill-health, may obtain four months' leave on full pay, on a medical certificate.

4. Wounded officers, and those who are decorated with the St. George's Cross, may, during their journey home to be nursed, receive a mileage allowance, and a daily allowance of 1 rouble, if under field rank, and of 1½ roubles if field officers, if they travel by rail, or the regulation road allowance if they journey by carriage. Formerly, these favours were only accorded to wounded officers and at the special request of the general officer commanding the military districts.

5. Leave of absence may be granted at any time during the year, even during the stay in camp. Sick leave is always given without difficulty. Leave for family affairs or for purposes of rest may be granted, taking into account the number of absentees and the gravity of the case. In every unit, brigade, or division only one quarter of the *personnel* may be on leave at the same time. Thus a regiment may send on leave at the same time a quarter of its subaltern officers, a quarter of its company commanders and one battalion commander, and an infantry division one of its regimental commanders. There is no fixed rule laid down for general officers or for functionaries holding similar rank. Their superiors may, however, grant them leave, taking into account both the requirements of the Service and the interests of the officers concerned. Care should be taken, however, that all officers may equally enjoy their right to leave, and may have proper rest.

6. The new rules with regard to leave for rest have been so framed that officers may enjoy it on the spot, viz., in their garrison itself. In this case they will remain for disciplinary purposes under their regimental commander, but are otherwise under the authority of the officer commanding the place, in the same manner as all other officers on leave of absence.

7. Short leave, viz., four months and less, may be given in a general way by the regimental commander. Long leave, from four months to a year, is granted by division commanders or by authorities having similar powers.

8. Long leave may only be granted to field and other officers actually serving, and in that case, those of them who command battalions, companies, etc., are relieved from their duties, remaining on the roll of their corps, and may resume their functions on their return from leave.

9. General and field officers, and officers serving on the staff, etc., cannot obtain long leave of absence, because their temporary absence would be injurious to the interests of the Service.

Such are the chief conditions of the new regulations, which are, as is seen, very favourable to Russian officers.

In Germany, officers may obtain leave of absence with pay for six months. For one and a half months they always receive full pay. For leave exceeding that period a daily reduction of 1 to 2 marks is made on the pay of subaltern officers, of from 4 to 9 marks on that of field officers, and of from 12 to 16 marks for general officers. No leave in excess of six months is granted, except in the event of illness; in that event, an officer receives his pay for the first six months; for the remainder of his leave he can only draw pay by Imperial authority.

In Austria-Hungary, full pay on leave is only given: 1. On leave of absence not exceeding eight weeks, to which officers are entitled annually. 2. In case of sickness for leave of absence for three, and under special circumstances for six months. The Minister of War has the power to extend the three months to six months' leave of absence, if there is any hope of ultimate recovery.—*La France Militaire.*

UNITED STATES. — The annual report of Major-General Henry C. Corbin, Adjutant-General of the Army, shows that the distribution of the Army on 25th September, 1901, was as follows:—

United States, 33,874; Philippine Islands, 43,239; Cuba, 4,914; Porto Rico, 1,541; Hawaiian Islands, 256; China, 162; Alaska, 527; total, 84,513.

The regiments in the Philippines will be reduced by the expiration of terms of enlistment as follows:—October, 1901, 665; November, 1901, 2,360; December, 1901, 3,017; January, 1902, 2,512; February, 1902, 2,163; March, 1902, 3,543; April, 1902, 2,224; May, 1902, 1,511; June, 1902, 2,492; total, 20,487.

The question of the strength at which the regiments in the Philippines are to be maintained is one requiring the early consideration of the War Department.

The losses from all causes from 1st July, 1900, to 30th June, 1901, were:—In the Regular Army, officers 161, enlisted men 16,808; Volunteers, officers, 313, enlisted men 7,776. Grand total, 25,058.

The total number of troops that served in the Philippines between 30th June, 1898, and 30th June, 1901, was 3,477 officers and 108,800 enlisted men. Of these 61,275 were Regulars and 50,002 Volunteers. The casualties from all causes among the troops in the Philippines were as follows:—

Cause.	Regular Army.		Volunteers.		Aggregate.
	Officers.	Men.	Officers.	Men.	
Killed	28	261	22	388	699
Died of wounds	6	78	6	129	219
Disease	18	1,082	18	1,028	2,146
Accident	1	61	4	38	104
Drowned	1	128	4	61	194
Suicide	2	35	4	15	56
Murder or homicide	1	46	—	28	75
Total deaths	57	1,691	58	1,687	3,493
Wounded	49	993	133	1,653	2,828

The casualties among commissioned officers of the Regular Army were 161.

With an average enlisted strength of 71,173 men, the number of desertions reported (3,110) is only 4·3 per cent. of the average strength, while for the last six months of that period the rate was 1·9 per cent., the lowest ever reported.

All reports show that the officers and men are in a good state of discipline. The enlisted men have never been of a higher character, as is shown by the fact that from the ranks during the year, after careful and rigorous physical and mental examination, 200 have been commissioned.

The muster out of Volunteers in every case was "quiet, orderly, and without incident," and fully 97 per cent. purchased railroad tickets to their respective homes. As the result of a medical examination prior to muster out in order to secure a correct record of the physical condition of these, 18,117 individuals, or over 81 per cent., make no claim of disability, although upon examination 100 of this number were found disabled, 4,168 claimed disability, and 485 claims were allowed; in 3,599 cases disability was found not to exist, and in the remaining 83 cases disability was not contracted in the line of duty. Claims for disability contracted in the line of duty were allowed in but 586 cases, less than 3 per cent. of the total number present for muster out.

It is very gratifying to note from the reports made that the discipline of the Volunteers while in camp was so uniformly good as to call for little criticism, fully justifying in that respect the wisdom of the method adopted of organising them and of selecting the senior officers from the Regular establishment. These officers were in every instance selected for purely military reasons. The Line officers were selected on their efficiency records as Volunteer officers. All in all, the Government has never had more satisfactory troops than these Volunteers, and these troops are entitled to the gratitude of the people and the Government.

The work of the Map Section of the Military Information Division has all been of the most satisfactory character. Especially have the maps of China been of very great value.

During the sessions of Congress, when the War Department was called upon to furnish copies of important and sometimes secret letters and documents, etc., to the committees and members, these papers were sent over to the gallery of the photographic rooms of the Information Division to be photographed and facsimile copies of them made, which were furnished, and they answered all the purposes required, and the necessity for taking the originals from the files and letting them pass out of the possession of the Department and running the risk of losing them was thus avoided.

The proper selection of officers for the important and delicate duty of military attaché is greatly hampered and restricted by the fact that the additional expense involved by his acceptance of a detail is so burdensome, that only those possessing private means can afford to serve. It is recommended that every officer while so serving shall have at least the rank, pay, and allowances of a lieut.-colonel.

So far the system of staff details authorised by the act of 2nd February, 1901, has fully met expectations.

Notwithstanding the enormous amount of time, thought, and labour, devoted to the instruction and general training of officers and men of the Army, there is no coherent plan which carries forward the work from one grade to another, and connects the valuable work done in the various schools. The system of training for the officers should begin with elementary technical instruction at each post, and terminate in the higher training which would be provided by a War College—the speedy and complete organisation of which is most desirable. Examination by carefully selected boards, capable of determining an officer's practical and technical ability to perform the duties of his grade, appear to be an essential element in any worthy record system.

It is regarded as most desirable that officers of the National Guard or Militia be authorised to participate in the work of the Service schools and the War College. Officers who, by their industry, ability, and general intelligence, commend themselves as worthy of special recommendation in the various schools should receive the highest possible consideration with a view to utilising their services for any service requiring special aptitude and ability. The services of a number of selected young officers have been availed of from time to time in the military information division of the A. G. O. and an immense amount of painstaking and important work has been accomplished. Work is already in progress enlarging the facilities of the several Service schools. It will take some little time to complete the contemplated improvements at all the posts where the Service schools are established and to get them in smooth running order.

Especially deserving of consideration in connection with this scheme, or any other which may be adopted, is the proper development of the military instruction of students in the various colleges of the country. Since the Department authorised the detail of retired officers with full pay a number of officers have sought the detail for the material benefit accruing from full pay and allowances over retired pay. It is reported that some of these officers do not even live at the colleges and only occasionally visit them.

In view of the fact that undesirable men have come into the Service as officers under the Act of 2nd February, 1901, authorising competitive examinations for candidates seeking commissions, it is recommended that each candidate should be a "non-commissioned officer in good standing who has displayed an aptitude for command and control of men" be revived; those who qualify to be sent to one of the Service schools —say, for six months—which should take the place of the second examination, and only those who demonstrate the proper qualifications should be nominated for commissions. Another proposition suggested commends itself, which is to detail annually one non-commissioned officer, to be selected by a board of officers in each regiment, to represent the regiment for one year at the Service schools, and such proportion from the Artillery Corps and other branches having enlisted men as would equal this ratio; vacancies not required for graduates to be filled from this class. A full enlistment of three years should be required of all candidates for commissions, including service at the school.

The net value of the post exchanges—that is to say, the balance of their combined assets over their liabilities—was on 30th June, 1901, $353,748·40 (£73,697 10s.).

The total number of enlistments and re-enlistments in the Regular Army during the fiscal year ended 30th June, 1901, exclusive of the Hospital Corps, was 30,622. Of these 26,267 were native born, 3,977 were of foreign birth, and 378 were born in Porto Rico. The enlistments numbered 25,688, and the re-enlistments 4,934. Excluding re-enlistments, the percentage of natives among the original enlistments was 89. The rejected applicants for enlistment numbered 86,407, or 74 per cent. of the whole. Including those for the Hospital Corps, the total of enlistments and re-enlistments was 31,458.

The Army transport service on the Pacific, while honestly and efficiently administered under the direction of sailing masters of experience and ability, is, under the present order of things, believed to be costing the Government considerably more than the amount required for the same Service by ships of commercial companies. It would seem that Congress could with safety offer certain inducements to those engaged in the shipping business of the United States to install a line of steamers under such charters as would in time of necessity serve the Government as reserve Army and Navy transports.

Ever since the American occupation of the Philippines, nothing has been so uncertain as the mails. Another and kindred subject, and perhaps of equal importance, is the necessity for a domestic cable to the Philippines.

The comparative order now prevailing in the Philippine Archipelago would make it wise at an early date to assemble the troops at certain strategic points and house them in comfortable quarters.

If the Government adopts the recommendations which have been made as to the erection of storehouses in Manila and vicinity, the cost of maintaining the troops in the Archipelago will be scarcely more than in garrisons in the United States, and the health and comfort of the officers and men will be assured.

Early consideration should be given to the desirability, if not necessity, of many changes in the uniforms of officers, especially with regard to belts, shoulder knots, and shoulder straps. The heavy dress hats, now prescribed by the regulations, are cumbersome, expensive, and not adapted to the present requirements of the Service.

Officers in active service should be provided with servants duly enlisted as such, whose compensation should be reimbursed by the officers. These men should be provided with the uniform that will distinguish them from the rank and file.

The recommendation is renewed, that all officers who had served in the war of 1861-1865, and have continued in the Service during the recent war with Spain, be placed upon the same footing as officers of the Navy, and retired with one grade higher. It is especially recommended that the Congress authorise the retirement of not to exceed two major-generals on the active and one on the retired list, with the rank of lieut.-general. The Department has in mind the faithful and distinguished services of Major-Generals Merritt, Brooke, and Otis, who were general officers at the beginning of the Spanish-American War.

It has been urged that Service medals be given all officers and men, of the Regular and Volunteer troops, who honourably served in the war with Spain, in the Philippine Islands, and in China. This is a practice quite general in all other Armies, and is commended.

All the subordinate officers of the department have, without exception, performed their duties with zeal and intelligence. It is not too much to say that the Government never had a more loyal, intelligent, and faithful set of public servants than they have shown themselves to be.

Surgeon-General Sternberg's report of the work of the Army Medical and Hospital Department during the fiscal year ending 30th June, 1901, serves as convincing testimony to the efficiency and zeal of this branch of our military Service. In view of the extensive scope of the operations described, and of the trying conditions under which they were conducted, the results which have been accomplished are extremely creditable to all concerned.

The receipts of the Department for the year were $2,196,304.20 (£457,563 7s.), the disbursements $1,853,269·75 (£386,097 14s.). Medical and hospital supplies during the year were abundant and of good quality; modern apparatus and appliances for the diagnosis and treatment of disease and injury were promptly furnished; and with improving conditions in our foreign possessions, together with the concentration and reduction of the military forces stationed there, the work of the Supply Department has been greatly simplified and diminished.

The one achievement which stands out more prominently perhaps than any other in this record of useful service is the virtual extinction of yellow fever in Havana by the board appointed for the study of that disease. The investigations undertaken by this board have demonstrated that the bacillus of yellow fever bears no causative relation to the disease. It was also established by scientific experiment that the mosquito is the intermediate host for the parasite of yellow fever. It is held, further, that an attack of yellow fever caused by the bite of an infected mosquito renders the victim immune against a second attack, that the disease can be most effectually controlled by the destruction of mosquitoes, and the protection of the sick against the bites of those insects. It is interesting to note the significance of these results. Yellow fever has been conquered by American genius and courage. The city of Hanava is rid of the disease for the first time in 140 years, and so marvellous has been the improvement in health conditions in Cuba since the American occupation that the people of the island may yet declare quarantine against the ports of our South Atlantic States as a protective measure!

The Surgeon-General renews his recommendations for systematic medical inspections by chief surgeons, and favours a regulation which shall require such officers to visit each post in their respective departments at least once a year.

The patients treated in the Army and Navy General Hospital, Hot Springs, Ark., during the year numbered 396. 27 officers were returned dismissed greatly improved and 208 of the 369 enlisted men. The establishing of a sanitarium at Fort Bayard, N. M., for the treatment of pulmonary consumption has been amply justified by experience. In this establishment, which at an altitude of 6,040 feet has a climate which makes outdoor life enjoyable throughout the year, 344 patients received treatment, 184 were discharged, 40 died, and 120 were still under treatment on 30th June, 1901.

With reference to the appointment of medical officers, it appears that while the percentage of candidates approved by examining boards recently in Session is 28·84, as compared with 19·23 per cent. approved by the boards of former years, there has been no lowering of the standard of qualifications. Many of the recent candidates were young men who had already proved their fitness as Volunteer or contract surgeons, hence the ratio of successful applicants was much higher among them than it was among those who appeared before the earlier boards. There were 387 contract surgeons employed during the year and 14 dental surgeons.

Special attention was given during the year to the instruction of men for the Hospital Corps at the Army General Hospital, Washington Barracks, D. C., at Fort

McDowell, Cal. (Angel Island), and at Hospital No. 3, Manila, P. I. Most valuable work has been done.

39,916 men were examined for enlistment, the ratio of acceptances being considerably smaller than usual, 56·32 per cent., against 70 per cent. in 1897, 77·04 per cent. in 1898, and 68·12 in 1899. The Army is becoming more and more vigorous. The health of the Army has been unusually good. There was an increase in the ratios of death, discharges, and sick report over those of 1897, when they touched the lowest level on record, due to the relatively large proportion of our force which served under bad war conditions in China and the Philippines.

The troops serving in the United States exclusively had a ratio of 1,510·97 of strength for admission to the sick report, last year, as against a ratio of 1,677·51 for the year preceding. The troops serving in the Philippines had an admission rate of 2,621·96 last year, as against a ratio of 2,395·52 for the year before, the increase being due to disease among the Volunteers, their admission ratio having risen from 1,859·21 to 2,761·70, while that of the Regulars declined from 2,454·10 to 2,197·73. Two-thirds of the admissions for diseases resulted from malarial fever and diarrheal diseases. The death rate from all causes was 28·75, as against 30·58 the year before. The latest reports show that the health of the troops in the Philippines is steadily improving, and there is a progressive diminution in the non-efficiency of the command from disease and injury.

The death rate among the American troops in China was 47·76 per 1,000—23·62 from disease and 24·14 from injury. Conditions in Cuba show a remarkable improvement, the death ratio among our forces, from all causes, having fallen from 18·30 per 1,000 in 1899 to 9·78 last year.

The condition of our troops in Porto Rico is even more gratifying. With a total force last year of 2,180 the death rate was only 5·05 per 1,000, as against 11·27 in 1899, which is lower than the lowest recorded rate for troops in our own country.

The Surgeon-General's figures show that for tuberculosis of the lungs the admission rate for the year was 4·92 per 1,000, which is considerably higher than the annual average for the preceding decade. The rate was higher among the troops here in the United States—5·27—than among any of our commands operating elsewhere except that serving in China, in which it rose to 7·70. The lowest rate was in Cuba, where it was 3·80, while in Porto Rico it was 4·59.

The admission rate last year for venereal diseases was 133·97 per 1,000, as against 133·00 for the preceding year. The increase of these diseases in the Philippines is pronounced. In April, 1901, they constituted 20·42 of the total sickness among the troops as compared with 8·97 in September, 1900. The health authorities of Manila have adopted measures to segregate and control the women of the town, and the military authorities have given orders for the inspection of the troops at regular intervals.

The admission rate for alcoholism for the Army as a whole last year was 15.34 per 1,000 as against 14·49 for the year before, and an annual rate of 28·67 for the decade preceding. The admission for alcoholism among the Regular troops have undergone a steady decline, falling from 41·41 in 1889 to 40·75 in 1890, to 40·10 in 1891 to 37·25 in 1892, to 33·97 in 1893, to 30·94 in 1894, to 30·11 in 1895, to 29·06 in 1896, and to 27·86 in 1897. Changed conditions in the Army, beginning with the enlistment of a large Volunteer force for the Spanish War, render further comparisons impossible. There is less drunkenness among troops in active service than in a command doing garrison duty in time of peace. In the Philippines the admission rate for alcoholism among the Regulars was 12·41, and among the Volunteers it was 8·68. The rate for our troops in

China was 7·70. Military officers may be said to be unanimous in the opinion that the improving condition of the Army in the matter of alcoholism is the result of the establishment of the post exchange or canteen at military posts.

The cases of insanity in the Army last year numbered 273, an annual rate of 2·72 per 1,000. During the year 1897 when all the troops of the United States were at home stations the admission rate for diarrheal diseases was 73·77 per 1,000 with no deaths. Dysentery was then a rare and seldom fatal disease. In 1898, as a consequence of war service in Cuba, Porto Rico, and the Philippines, the admission rate rose to 388·62, with a death rate of 1·45. In 1899, the admission rate had fallen to 380·69, but the death rate had risen to 2·14, while last year the admission rate increased to 465·01 and the death rate rose to 6·47. This marked increase was due to the exposure of a large proportion of the Army to the causes of diarrheal and dysenteric diseases in the Division of the Philippines. Among the Regulars engaged in those islands the admission rate was 488·25, and among the Volunteers it was 736·05.

The highest admission rate for pneumonia among our troops was here in the United States, where it reached 4·25 per 1,000, followed in China by 3·08, while in Cuba it was only 1·61, 2·29 in Porto Rico, and 2·12 in the Philippines.—*U. S. Army and Navy Journal.*

CORRESPONDENCE.

NOTES ON THE IMPERIAL YEOMANRY REPORT SUBMITTED 13TH MAY, 1901.

To the Editor of the JOURNAL OF THE ROYAL UNITED SERVICE INSTITUTION.

Sir,—Would you permit me, as an old adjutant of Yeomanry, to make a few remarks upon the interesting and instructive Report on the Yeomanry recently published by the War Office?

"The want of proficiency of riding and shooting was a marked characteristic of recent operations as noticed by many general officers. The idea of our being a nation of horsemen is somewhat exploded, at all events in the sense of men being able to ride without training" (page 120).

When out with the Yeomanry at the yearly training, it was often remarked and I have heard other adjutants of Yeomanry say the same, as to how well the old cavalry sergeant-majors of troops kept up their riding knowledge and training, as they rode but little during the year except during the training, and then they often rode young horses found them by their captains. Does this not show the advantage of being instructed in riding on a system, instead of being self-taught?

"This points to the desirability of having some system of central riding schools as is the case with musketry schools and gymnasiums. If at some of the chief Yeomanry brigade centres or Yeomanry headquarters there could be kept up a small number of horses for military equitation, the system would be of much assistance in obtaining and instructing Yeomanry recruits" (page 121).

These remarks are very much to the point; take, for instance, the university towns of Oxford and of Cambridge; ought not riding schools to be established in them, especially as now young men who are appointed to civil posts in India are obliged

to pass an examination in equitation? I knew of a young collegian who, having passed all the examinations for the Civil Service in India, had to be instructed in riding, first at Oxford by a sergeant-major of the Oxfordshire Yeomanry, then in a riding school in London, and ultimately had to pass his final examination at Woolwich. Probably outside *manèges* would suffice for some county regiments, but such riding schools at Oxford and Cambridge are now necessities and might perhaps be subsidised by the universities, and without doubt would be very popular with the young collegians.

In Lord Pembroke's "Military Equitation," 1761 (our first writer on military equitation) he mentions "riding money" which was an allowance paid to the colonel of cavalry regiments for the paying of the expenses of teaching equitation and for the breaking of horses. Might not this old term be again used with advantage, so as to keep this fund separate from the Contingent Fund of a Yeomanry regiment, as also to lay stress on the importance of the art of riding? This fund might also vary according to the requirements of Yeomanry regiments. The military riding schools have been used by Yeomanry regiments where possible, and riding schools were much advocated in an able lecture at the R. U. S. Institution in Vol. XXXV., May, 1891, by Lieut.-Colonel the Hon. H. G. S. Crichton, late 21st Hussars, and Hants Yeomanry; and by Captain Frank Green, Yorkshire Dragoons (Doncaster), in the *United Service Magazine*, March, 1900, "The Future of Yeomanry," and probably by other Yeomanry officers.

Sir John Gilmour, Bt., Lieut.-Colonel of the Fife Light Horse, has erected a riding school at Cupar Fife for the use of the regiment he commands; this is, I understand, also used by the Volunteers as a Drill Hall, which are so necessary at the headquarters of many Volunteer regiments, and the need for which was commented on at Oxford, on 12th October, 1901, when the medals were distributed to the Oxford Volunteers who had returned from South Africa.

Might not this difficulty be met if a riding school was erected at Oxford?

On page 129 "Pelham Bits" are advocated for Yeomanry "as preferable to the heavy military pattern, but they should be broader and stronger than those hitherto supplied." Is not this going against the experience of ages, getting rid of that invaluable bit, the bridoon (or snaffle), and of that important method of riding on the bridoon as described at page 55, Cavalry Drill, 1898. "Take up your bridoon reins"; and at page 56, paragraph 6, "Bridoon reins are always to be taken up when marching at ease, going over jumps or manœuvring over bad ground."

Would it not be as well if riders made more use of this method, when riding with "two hands" (the left bridoon rein with bit reins being in the left hand and the right bridoon rein being in the right hand), they would find to a nicety how they could with the use of the legs balance their horses on their haunches, and keep them collected more or less as wished for.

As to the wording "Pelham bits are preferable to the heavy military pattern, but they should be broader and stronger than those hitherto supplied," is this description sufficiently explicit? Say the mouthpiece ought rarely to exceed $4\frac{3}{4}$ inches width, this is the size now being supplied for South Africa, and the cheek might be $7\frac{1}{2}$ inches in length, and the whole bit made in proportion, the mouthpiece to be of good size, 2 inches to $2\frac{1}{2}$ inches circumference.

As a matter of course, cavalry regiments, such as the Life Guards, would require rather larger bits on account of the size of the horses, and a few bits of various sizes to each regiment as is described page 105, Cavalry Drill, 1898.

There was a very instructive Exhibition of Saddlery at the Saddlers' Hall, Cheapside, in June, 1892.

The following measurements taken at the time may be of interest. The German military exhibit did not arrive in time.

Nation.	Full length of cheek.	Width of mouth-piece inside.	Thickness of mouth-piece.	Remarks.
Austria	6½ inches.	4½ inches.	½ full.	The length of the cheek is from the top to the bottom. The diameter of the mouth-piece was taken, but the circumference is the proper mode of measurement, ½ inch diameter may be taken as 2 inches circumference.
Italy	6½ „	4¾ „	½	
Belgium	6¾ „	5¼ „	½ full.	
France	7 „	5 „	½ „	
United States... ...	7¼ „	4¾ „	½ bare.	
England	8½ „	5 „	⅝	
Hunting bits	7½ inches.	4½ inches.	¼	
„	8 „	5 „	½	
„	9 „	5½ „	¾	

The Pelham recommended (it is supposed) is the one called "The port-mouth reversible bit," see page 17 in the Regulations for Mounted Infantry, 1899. This bit has the movable mouthpiece, of little advantage, whilst it has the disadvantage of wearing out more quickly than the ordinary fixed mouthpiece and is liable to pinch the lips of a horse. It also has the reversi ble bar, this is not necessary and suggests harsh handling or bad breaking.

Without a doubt, Pelham bits will deteriorate the men's hands and not improve them. In this war in South Africa the bridoon (or snaffle) is found most useful. Lieutenant Vander Byl, 16th Lancers, "Patrolling in South Africa," page 16, writes: "Nineteen horses out of twenty go perfectly well without bits and with bridoons only in their mouths. Therefore do away with your bits when they are not required." And Lieutenant Anley, late Adjutant 5th Regiment Mounted Infantry, "Practical Hints for Mounted Infantrymen," page 15, "Horse Equipment," "Snaffle and Single Rein," at page 29, says :—"Should there be a halt for a quarter or half-an-hour, remove the snaffle, passing it under the chin, and put on the nose-bag."

Evidently the bridoon (snaffle) meets most of the requirements in this war in South Africa ; and why are the Imperial Yeomanry to be given bits such as Pelham's, which may only make heavier the hands of the rider !

Why now advocate Pelham bits—a bit which has made no advance with civilian riders—is it not faulty both theoretically as well as practically ? See Captain Hayes' "Riding and Hunting, 1901," page 36, "Action of Pelham's":—"When both reins are taken up, its action is usually very faulty ; because its cheek reins will then as a rule, draw the mouthpiece so high up in the mouth, that the curb chain will come on the sharp edges of the branches of the lower jaw, and a downward pull will be transmitted to the headstall. Hence the user of a Pelham should not tighten both the curb and the cheek rein at the same time."

As to the old-fashioned bridoon (or snaffle) in combination with the ordinary military or hunting curb, if horses and riders cannot get on together with these bits, is it not a sign of the want of proper training on the part of both or either ? The

military curb is identical with the ordinary hunting curb in principle, the pattern of the cheek being only varied to prevent the horses catching the cheek pieces in their mouths and the bar at the bottom of the bit being intended to prevent them getting caught in the reins of other horses when standing in the ranks together.

In defence of the present cavalry bridle of the English Army, Major-General Hallam Parr, C.B., notes on "Mounted Infantry, 1900" page 46, writes:—"Mounted infantry officers are prone to treat with patterns of Australian and Colonial bridles." This is a great mistake. "The cavalry bridle of the English Army is the best extant in Europe and only needs to have less metal in the bit. Altogether it is a thoroughly practical and workmanlike article."

May not these Colonial bridles be the channel whence Pelham's are advocated for mounted infantry and now for the Imperial Yeomanry?

To those who advocate mouthpieces such as straight bar bits and mulling, or half moon, might it be suggested that they should drive in single harness with the headstall fitted with the ordinary mouthpiece and with separate side cheeks to carry the bridoon (as is now often used since the snap billeted bearing rein has been introduced)? and by changing the driving reins from one bit to the other, they will feel when on the bit (at the cheek) that it is like a rigid piece of wood, and when changed to the bridoon it is soft, and by using a rein in each hand the driver can balance his horse and supple him, as one saw at the Richmond Horse Show carried out by Mr. Gooch of Windsor, and Mr. Howard, the well-known breaksman, and others at other times.

Moreover, in the streets of London one has only to watch hansom cab horses driven on the double ring bridoon, and other horses on a straight bar bit, and an experienced eye can soon assure himself as to which bit the horse is most comfortable in, as well as more handy and less stiffened.

It is to be hoped when another edition of Cavalry Drill is published, that the bit reins will be divided by the third finger of the left hand, instead of the little finger: this was the instruction in the Mounted Infantry Regulations for 1884, and probably inserted by some experienced hunting man. This instruction was altered in 1889—the reason is wanted. The third finger divides the bit reins in all the cavalry of the Continent, except the French, who use the old method mentioned in Adams 1808, and may be well for arms in the right hand, but it is not adapted for general horsemanship—see Lieutenant Le Marquis de Ste. Phalle, 2nd Hussars, "Dressage et Emploi du Cheval de Selle," 1899:—"Telle est, je crois, la raison pour laquelle cette tenue des reins *éridemment peu commode au point de vue d'équitation pure*, est maintenue par nos règlements militaires."

As to horsemanship in England, there is not a doubt that it has deteriorated of late years. The views expressed in this report are supported by the experience of many, and Lieut.-Colonel Maude, late R.E., in the *St. James's Gazette*, of 24th October, shows clearly that the changes of the last few years in the facility of the moving by trains, cycles, etc., must have diminished the opportunities of riding and of horse knowledge. It is to be hoped that if the use of riding schools and *manèges* with competent instructors become common through the requirements of the Imperial Yeomanry, the love of horsemanship may increase and be strengthened by the proper teaching of the art of equitation instead of the self-teaching only, for which there will be plenty of opportunities to practise when riding about either in civilian or military duties.

I may add this report contains a list of five useful handbooks on horse management, which were supplied to the Imperial Yeomanry on embarking for South Africa, thus showing care on the part of the War Office and of those in charge of the Yeomanry.

Yours obediently,

F. I. DASHWOOD, Major,
Late 16th Lancers, and late Adjutant O.Y.C.

The R.U.S. Institution, Whitehall.

For those who are interested in this matter, the following list of authorities may prove useful :—

The Report, pages 120, 121, 124, 54, and 56.

1761. Lord Pembroke, "Military Equitation." Riding money.
1808. Adams, "Horsemanship."
1869. Major F. Dwyer, "Bits and Bitting."
1871. Latchford, "The Lorrimer" Fig. 7. Mulling Mouth Snaffle.
„ 28. Melton Bit.
„ 33. Pelham Bit used in Mounted Infantry.
„ 94. Cavalry Bit.
Page 34. Classes of Mouths and Measurements.
1884. Mounted Infantry Regulations.
1891. R.U.S. JOURNAL. Vol. XXXV. Lieut.-Colonel the Hon. H. Crichton, "Riding Schools."
1898. Cavalry Drill.
1899. Mounted Infantry Regulations.
„ Lieutenant Ste. Phalle, 2nd Hussars, "L'Emploi du Cheval de Selle."
1900. Do. Letter 4th March.
„ Major-General Hallam Parr, "Further Notes on Mounted Infantry."
„ *United Service Magazine*, Captain Green, "Riding Schools."
„ Lieut.-Colonel Alderson, "Pink and Scarlet."
1901. *Bailey's Magazine* for March, "Sir John Gilmour, Bt."
„ Oxford Volunteers, "Drill Hall," Oxford, 22nd October.
„ Richmond Horse Show, "Driving on the Bridoon."
„ Captain Hayes, "Riding and Hunting."
„ Lieutenant Vander Byl, "Patrolling in South Africa."
„ Lieutenant Anley, "Practical Hints for Mounted Infantry."
„ Lieut.-Colonel F. Maude, late R.E., letter in *St. James's Gazette*, 24th October.

Messrs. Whippy, Saddlers, North Audley Street.
„ Parker Bros., Saddlers, Upper St. Martin's Lane.
„ Tattersall's, Albert Gate.
The Indian Office, St. James's Park.

NAVAL AND MILITARY CALENDAR.

DECEMBER, 1901.

1st (S.) Orders were issued at Allahabad for the mobilisation of the Reserve Brigade for operations against the Waziris.

5th (Th.) Lord Kitchener reported the capture of 3 Boer laagers and over 200 prisoners.

" " The 2nd Dragoon Guards (Queen's Bays) arrived at Cape Town from England on the "Oratava."

6th (F.) 1st Bn. Black Watch (Royal Highlanders) } Left India for South Africa
" " 2nd Bn. Essex Regiment } on the "Armenian."

7th (Sat.) Lord Kitchener reported that Colonel Mackenzie captured Lyon's commando.

9th (M.) Major-General Sir H. Chermside, G.C.M.G., C.B., R.E., was appointed Governor of Queensland.

10th (T.) Q Battery R.H.A. left Cape Town for England on the "Ranee."

11th (W.) H.M.S. "Melita" arrived at Plymouth from Mediterranean.

" " Lord Kitchener reported that Major-General Bruce Hamilton had surprised and captured the Bethel commando. 7 Boers killed, 131 prisoners.

" " 4th Bn. King's Royal Rifles left Ireland for South Africa on the "Roslin Castle."

12th (Th.) 2 squadrons 20th Hussars } Left India for South Africa
" " 2½ companies 2nd Bn. Royal Munster Fusiliers } on the "St. Andrew."

13th (F.) 1 squadron 3rd Hussars }
" " 2 squadrons 20th Hussars } Left India for South Africa
" " 1½ companies 2nd Bn. Royal Munster Fusiliers } on the "Custodian."

14th (Sat.) H.M.S. "Dido" arrived at Sheerness from China.

" " H.M.S. "Vestal," "Mutine," and "Fearless" left for China.

" " Lord Kitchener reported that Piet Viljoen's laager at Witkraaus was captured by Major-General Bruce Hamilton. 16 Boers killed, 70 captured.

15th (S.) Colonel Colenbrander captured Commandant Badenhorst and 14 Boers at Sterkfontein.

16th (M.) 4th Bn. Rifle Brigade (the Prince Consort's Own) left Ireland for South Africa on the "Orient."

17th (M.) H.M.S. "Isis" arrived at Spithead from China.

" " H.M.S. "Pearl" commissioned at Devonport for the Cape.

" " Lord Kitchener reported the capture of Kritzinger in Cape Colony. Potgieter's Laager was also captured.

" " 5th Bn. Royal Warwick Regt. (Militia) } Left England for South Africa
" " 3rd Bn. the King's (Liverpool Regiment) (Militia) } on the "Plassy."

18th (T.) H.M.S. "Rainbow" commissioned at Devonport for the Training Squadron.
" " Orders were issued for the preparation of 1,200 Foot Guards for South Africa.
" " General Dartnell had a fight with De Wet and 800 Boers and drove them off.
19th (Th.) Major Allenby captured 32 Boers, including Major Pretorius of the Staats Artillery.
20th (F.) 1st Bn. Black Watch (Royal Highlanders) } Arrived at Cape Town from India on the "Armenian."
" " 2nd Bn. Essex Regiment }
" " 3 squadrons 3rd Hussars }
" " 4 companies 2nd Bn. Royal Munster Fusiliers } Left India for South Africa on the "City of Vienna."
21st (Sat.) H.M.S. "Rinaldo" left for China.
" " 6th Bn. Worcester Regiment (Militia) left England for South Africa on the "Manila."
23rd (M.) 7th Hussars arrived at Cape Town from England on the "Templemore."
24th (T.) De Wet successfully rushed Colonel Firman's camp of Yeomanry at Tweefontein. British losses very severe.
" " 3rd Bn. York and Lancashire Regiment (Militia) } Left England for South Africa on the "Aurania."
" " 3rd Bn. Highland Light Infantry (Militia) }
26th (Th.) 3rd Bn. Lancashire Fusiliers arrived at the West Indies from Malta on the "Sicilia."
27th (F.) 2nd Bn. The Prince of Wales's Leinster Regiment (Royal Canadians) left the West Indies for South Africa on the "Sicilia."
28th (Sat.) Launch of first-class battle-ship "Missouri" at Newport News for U.S. Navy.
" Lord Kitchener reported that Major Beresford had captured 36 Boers at Bothasville.
" " Skirmishes took place at Lang's Nek and Botha, the Boers being driven off.
29th (S.) Botha failed in an attempt to cross the line at Standerton.
30th (M.) Colonel du Moulin captured a Boer laager and 28 prisoners at Jaegersfontein.
31st (T.) H.M.S. "Barfleur" arrived at Plymouth from China.

Addendum to November Calendar.

30th (Sat.) H.M. sloops "Odin" and "Merlin" floated out at Sheerness.

FOREIGN PERIODICALS.

NAVAL.

ARGENTINE REPUBLIC.—*Boletin del Centro Naval.* Buenos Aires: November 1901.—"Servomotors" (*continued*). "A Study on Actual Deflectors: Thomson Clausen, Garcis y Florian." "The Loss of the 'Cobra.'" "Regulation of Coast Fire." "Explosives for the Bursting Charges of Projectiles." "Life-Saving Apparatus." "Foreign Naval Notes."

AUSTRIA-HUNGARY.—*Mittheilungen aus dem Gebiete des Seewesens.* No. 1. Pola: January, 1902.—"Don John of Austria as Admiral of the Holy Alliance, and the Battle of Lepanto."

BRAZIL.—*Revista Maritima Brazileria.* Rio de Janeiro: October, 1901.—Has not yet been received.

FRANCE.—*Revue Maritime.* Paris: December, 1901.—"The Chronicles of Lorient" (*continued*). "The English Naval Estimates." "Syntonic Wireless Telegraphy." "Foreign Naval Notes." "The Mercantile Marine."

Le Yacht. Paris: 7th December, 1901.—"The *Inscription Maritime.*" "Yachting Notes." "The Mercantile Marine: French and Foreign." "The Russian first-class Battle-ship 'Retvizan.'" "The New Regulations for the Mercantile Marine." 14th December.—"A New Torpedo-boat Station at Lezandrieux." "Yachting Notes." "The New Regulations for the Mercantile Marine" (*concluded*). 21st December.—"Naval Mechanics." "Yachting Notes." "The English First-class Armoured Cruiser 'Cressy.'" "The Mercantile Marine: French and Foreign." 28th December.—"What Type to adopt for Ships of War." "Yachting Notes." "The Question of the Cadres." "The Russian Coast-Guard-ship 'Rotislav.'" "The Pendulum Propeller." "Recruiting for the German Mercantile Marine."

Le Moniteur de la Flotte. Paris: 7th December, 1901.—"The Gyroscopic Compass." "The Navy in Parliament." 14th December.—"The Regulations for the Mercantile Marine." "The Navy in Parliament." "The Mission of the 'Bengali.'" "The Service of the '*Inscrits Maritimes.*'" "Voluntary Enlistment in the Fleet." "The Medical Statistics of the Navy." 21st December.—"Long-Range Actions." "New Regulations for the Fleet." "The Navy in Parliament." "Wireless Telegraphy." "Trials of Submersible Boats." 28th December.—"Auxiliary Cruisers." "M. Lockroy's Report on the Naval Estimates." "The Naval Estimates Modified." "The Navy in Parliament."

La Marine Française. Paris: 1st December, 1901.—"The New Dover Harbour Works" (*continued*). "Naval and Military Manœuvres in Russia, 1901." "From the Bosphorus to the Persian Gulf: The Bagdad Railway." "Foreign Naval Notes." 15th December.—"The Fighting-Ship of the Future." "From the Bosphorus to the Persian Gulf: The Bagdad Railway" (*concluded*). "Foreign Naval Notes."

GERMANY.—*Marine-Rundschau.* Berlin: January, 1902.—"An Italian View of the Principles for Promotion." "The Defence of Tientsin in June and July, 1900" (*concluded*). "Arabia's Present and Future." "History of the Art of War, considered in the light of Political History." "The Loss of the 'Cobra' and its Lessons for the Construction of Torpedo-vessels." "The Probable Cause of the Present Destruction of Tubes on board Ships." "The Present Position of Cable Undertakings." "The Report of the State Secretary of the U.S. Navy."

ITALY.—*Rivista Marittima.* Rome: December, 1901.—"The Fighting Power of States." "Trials of Methods of Propulsion, with Models of Ships." "The Weak Points of Ships." "Commerce and Steam Communication with Australia." "The Glasgow Exhibition." Letters to the Director:—"Torpedo-boats." "About the use of Torpedo-boats in time of Peace." "On Collisions at Sea." "Foreign Naval Notes."

PORTUGAL.—*Revista Portugueza, Colonial e Maritima.* Lisbon: November and December, 1901.—Have not yet been received.

SPAIN.—*Revista General de Marina.* Madrid: January, 1902.—"Organisation." "?" "The New Russian Battle-ship 'Kniaz-Potemkin-Tavritchesky.'" "The True Account of the Battle off Cape Sicie on the 22nd February, 1744." "Conning-Towers." "The New Tug for the Ferrol Arsenal." "Naval Wireless Telegraphy." "Auxiliary Ships for a Battle-Squadron." "The Russian Manœuvres for 1901." "Calculation of the Luminous Power of Light-houses" (*continued*). "Turkey: Its Fleet." "Foreign Naval Notes."

MILITARY.

AUSTRIA-HUNGARY. — *Militär-Zeitung.* Vienna: 8th December, 1901. — "Schools for the Practical Instruction of the Rank and File." "Captain Ravon's new French Field Gun." "German Professors on the English Conduct of War." 16th December.—"On Duelling." "Machine Gun Groups." "The New Military Technical School at Charlottenburg." "Notes by General von Blumenthal on Königgrätz." 24th December.—"Christmas in Barracks." "Permanent Supplementary District Commanders and Supplementary District Officers." "War Minister von Gossler and the Duel with the Citizens." "Staff Officer's Promotion in Russia."

Mittheilungen über Gegenstände des Artillerie- und Genie-Wesens. Vienna: December, 1901. — "Rule of Fortuitous Deviations." "Electric Light in the last Twenty Years."

Organ der Militär-wissenschaftlichen Vereine. Vienna: Vol. LXIII., Part 4.—"Battles and Actions at Kronstadt." "Liquid Air."

BELGIUM.—*Bulletin de la Presse et de la Bibliographie Militaires.* Brussels: 15th December, 1901.—"The Anglo-Boer War" (*continued*). "The French War Budget for 1901." 31st December.—"The Anglo-Boer War" (*continued*). "The French War Budget for 1901" (*continued*).

FRANCE.—*Revue du Cercle Militaire.* Paris: 7th December, 1901.—"Russians and English in Central Asia." "The Swiss Army—The Manœuvres of 1901" (with sketch and map, *continued*). 14th December.—"Russians and English in Central Asia" (1 sketch, *concluded*). "The Swiss Army—The Manœuvres of 1901" (*continued*). "At the Philippines." "An Interrupted Awakening—An Incident of the War of 1870." "The Swiss Army—The Manœuvres of 1901" (2 maps and 2 sketches, *concluded*). 28th December. — "The Chilian Army — Presentation of Colours to Recruits." "Medical Statistics of the Austro-Hungarian Army for 1899."

Revue de l'Intendance Militaire. Paris: December, 1901.—Has not yet been received.

Le Spectateur Militaire. Paris: 1st December, 1901.—"The Campaign of 1813" (*continued*). "The Ancient Corps of Marines" (*continued*). "Round Kita" (*continued*). "Instructions of the 19th August, 1899, on the Fire of German Field Artillery" (*continued*). 15th December. — "The Campaign of 1813" (1 sketch, *continued*). "Round Kita" (*continued*). "The Ancient Corps of Marines" (*continued*). "Instructions of the 19th August, 1899, on the Fire of German Field Artillery" (1 sketch, *continued*).

Revue Militaire. Paris: December, 1901.—"Study of the South African Campaign, 1899-1900" (*continued*). "Military Events in China, 1900-1901" (*continued*). "Re-organisation of the United States Army." "Supernumerary Officers in the Russian Army."

Revue d'Histoire. Paris: December, 1901.—"The Campaign of 1794 in the Northern Army." "The Naval War of 1805" (*concluded*). "History of the 1809 Campaign—The Army of Italy."

Revue d'Artillerie. Paris: December, 1901.—"Lectures given in 1767 in an Artillery Regiment." "The Exhibition of 1900—Small Arms" (*concluded*). "The Schneider-Canet Artillery at the Exhibition of 1900" (with 2 plates).

Journal des Sciences Militaires. Paris: December, 1901.—"The Two Years' Military Service." "Questions of National Defence in the Maritime Alps." "The General Staff of the Army and the Chief Command." "Recruiting of Officers in France and Abroad" (*concluded*). "The Great Frederick" (*concluded*). "Defensive System of France" (*continued*). "A German Infantry Brigade in Action" (*concluded*). "The Volunteers of Isère during the Revolution" (*concluded*).

Revue de Génie Militaire. Paris: November, 1901.—"The Engineers in China 1900-1901." "Railway Work carried out by 5th Regiment of Engineers for the Review at Reims." "On the Use of Search-lights in War." "Analysis of and Extracts from Vauban's Correspondence" (*continued*).

Revue de Cavalerie. Paris: November-December, 1901.—"German Ideas on the Use of Cavalry." "The American Cavalry in the War of Secession." "The Promotion of Cavalry Lieutenants." "The Staff." "Lessons of the 16th August" (*continued*). "A Cavalry Regiment under the First Empire." "Report of Commandant de Carné on the Horse Resources of French Indo-China."

GERMANY.—*Militär-Wochenblatt.* Berlin: 4th December, 1901.—"The Assault on Fortified Field Positions." "Cross-Country Riding." "From the Editor's Note-Book." 7th December.—"Two Infantry Regiments of the Royal Saxon Army during their 200 years of Existence." "The Military Handbook of Bavaria." "A few Remarks of the Instruction of Tactics." "Military Knowledge and the Education of Youth." "Encouragement for Staff Officers in Russia." 11th December.—"Gunnery Practice with Q.F. Guns." "Summer Manœuvres of the 3rd Russian Cavalry Division." 14th December.—"General von Verdy's latest Work." "Thoughts on the Assault on Fortified Field Positions." "Aliso." "News from the French Army." 18th December.—"The English Conduct of War in South Africa." "The New Compilation of the Russian Regulations for the Calculation of the Numbers of Reservists and for their Calling out on Mobilisation, the Commission on Horses, Means of Transport, etc." 21st December.—"General von Verdy's latest Work." "On the Fight in Swiep-Walde." "German Officers in the American Army." 24th December.—"The Work of the French General Staff in the War of 1870-71." "On the Fight in Swiep-Walde" (*concluded*). "Military Intelligence from Spain." 28th December.—"The End of the Year." "Von Moltke's Strategy." "First Aid in the Fighting Line."

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"Report of the 1901 Commission on the Q.F. Gun Question." *Supplement 25.*—"This Year's Imperial Manœuvres in Hungary" (with 1 map). *French Supplement 33.*—"Study on Q.F. Field Guns Recoiling on Gun Carriage" (with plates). "Machine Guns." "The New German Torpedo-Boats." "Field Firing." "The Rights of People during a Campaign."

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Rivista Militare Italiana. Rome: 16th November, 1901.—"The Fundamental Social Laws." "The Geneva Convention and the International Resolutions at the Hague Conference" (*concluded*). "Alpine Mountain Artillery." "Automobiles and their Use in War." "Requisitions in an Enemy's Country." "Foreign Military Notes."

16th December, 1901.—"Other Times." "Military Physical Phenomena." "The Offensive in Savoy, Campaign of 1793" (*continued*). "Requisitions in an Enemy's Country" (*continued*). "A Glance at the Actual State of Military Cartography in the various European Countries." "Foreign Military Notes."

PORTUGAL.—*Revista de Engenheria Militar.* Lisbon: November, 1901.—"The Military Hospital of Lisbon" (*continued*). "The Walls of Lisbon" (*continued*). "Workshops of the Military Practical School of Engineering." "Report of the Committee Appointed to Study the Plan of a Railway to the South of the Tagus" (*continued*).

Revista de Infanteria. Lisbon: January, 1902.—"History of the Portuguese Infantry." "Practical Schools and Complementary Instruction." "The Mozambique Service Companies." "On a Two Years' Service and a Reduction of the Effectives."

SPAIN.—*Memorial de Ingenieros del Ejército.* Madrid: December, 1901.—"Visit of their Majesties to the Practical School of the 2nd Regiment of Sappers and Miners." "Ballooning." "Charcoal Exhibition at Barcelona." "The Importance of Electrical Verifications."

Revista Técnica de Infanteria y Caballeria. Madrid: 1st December, 1901.—"The Army in the 19th Century." "Infantry: Formations and Movements." "The Officers' List of the Portuguese Army." "A Resemblance Between Two Campaigns." "Side Arms in the Spanish Cavalry." 15th December.—"Military Service." "Changeable Strategy." "Side Arms in the Spanish Cavalry." "The Heads of the German Navy."

RUSSIA.—*Voïennyi Sbórnik.* St. Petersburg: November and December, 1901.—Has not yet been received.

SWITZERLAND.—*Revue Militaire Suisse.* Lausanne: December, 1901.—"Tactical Employment of Q.F. Guns with Shields in France." "The Neuchatel Guards Rifle Battalion from 1814 to 1848" (*concluded*). "Voluntary Aid Service in Switzerland and its Relations with the Army." "New Aiming Apparatus with Independent Foresight." "The German Imperial Manœuvres of 1901 in Western Prussia" (with map).

UNITED STATES.—*Journal of the United States Artillery Institution.* Fort Monroe, Virginia: November and December, 1901.—"Historical Sketch of the Fortifications of San Juan, and the English Attack in 1797." "Notes on Rapid-Fire Field Artillery." "A Discussion of the Errors of Cylindro-Ogival Projectiles." "The Modern Battle and the Effects of New Weapons." "Infantry under German Artillery Fire." "Upon the Form of the Head of Oblong Projectiles which Encounters the Minimum Resistance to Motion from the Air." "Experiments in Illustration of the Top Motion of Rotating Oblong Projectiles." "Professional Notes." "Book Reviews."

NOTICES OF BOOKS.

Der Siebenjährige Krieg, 1756-1763. Herausgegeben vom Groszen Generalstabe. Vol. II.—In Lobositz and Prag. Berlin: Mittler & Son. 1901.

It has been the custom in this country for some years past to deprecate the waste of time bestowed on the study of military history previous to the era of the breech-loader; evidently this is a view which the Prussian General Staff by no means shares, as a perusal of the above-mentioned works and their forerunners, "The 1st and 2nd Silesian Wars, 1742 and 1745," and of the "Kriegsgeschichtlichen Einzelschriften, Nos. 27 to 30," will abundantly prove.

Nevertheless, though the "Leitmotiv" is clearly defined, the standpoint of the several authors is open to considerable criticism, due no doubt to the difficulty of reconciling conflicting opinions, and one misses the master-mind of Moltke at every turn.

To put it shortly, the idea appears to be that, King Frederic the Great being a Hohenzollern, at the head of a Prussian Army, could do no wrong, and it is sought to prove that he did no wrong, because his actions can be twisted into conformity with the modern catchwords of military education; whereas we should prefer to put it that "The King was successful because he was a man of immense ability, who by degrees forged his own tools for the work he intended them to do, and thoroughly understood the true inwardness of the art of war, which Moltke has defined as 'the practical adaptation of the means at hand to the attainment of the object in view.'"

Let us briefly follow the steps of his evolution as a great leader, as it is revealed in the pages before us. At the close of the Wars of the Spanish Succession, the Armies of Europe stood all practically at the same level. The methods of recruiting were substantially identical, tactics, armament, and habits the same. Under these conditions the result of a battle had become so uncertain and the balance of advantage to be gained even by victory relatively so small, that only exceptional leaders could be found to take the responsibility of the unavoidably heavy losses fighting entailed upon the troops their Sovereigns had committed to their charge.

When Frederic ascended the throne, he found ready to his hand in the perfectly drilled Prussian infantry, a new factor which completely upset this existing equilibrium, and moreover he was responsible to no one.

Much has been made of the advantages the needle-gun conferred on the Prussians over the Austrians in 1866, and the Prussian victories are currently credited entirely to this cause; but in reality, when the Prussians took the field in 1742, they possessed a far greater relative superiority over their adversaries, due to superior drill, than the inventive genius of an individual has ever conferred on any European race until the Chassepot confronted the needle-gun in 1870—with quite opposite results, by the way.

At Mollwitz, the fire superiority of the Prussians was at least as three to one, at Sadowa not two to one, for though the breech-loader fired at least twice as fast as the muzzle-loader the latter had double the range, a flatter trajectory, and its bullet much greater stopping power. In France the Chassepot out-ranged the needle-gun by four to one, had double the rapidity of fire, a flatter trajectory, and a bullet which inflicted much more serious wounds; but, as at Mollwitz, the Prussians had cooler, better-drilled men behind their guns.

Seeing the advantage superior drill gave his men, the King promptly made the most of it, and from 1745 to 1756 he worked unremittingly to develop and improve it, as is shown in Nos. 28 to 30 of the "Kriegsgeschichtlichen Einzelschriften," where the record of his drills and inspections is fully given.

With the best will in the world the Austrians and French could not approach him in this competition—he as King could practically compel obedience; his opponents, as subordinates, could only solicit it.

As a consequence, when in 1756 the great war broke out, he had at his disposal a weapon on which he could rely with which to execute his plans, and was thus able to devise a strategy bolder in conception than anything that had gone before.

Moltke has been severely criticised for his invasion of Bohemia by three armies converging on Chlum. What then can be said of Frederic's almost identical plan in 1757, to concentrate his columns in the heart of an enemy's country from the same districts, over the same obstacles rendered worse by the absence of modern roads and without the aid of telegraphs and railways? The defence is the same in both cases, the superior fire power of the Prussian infantry justified the risks which were in fact greater by far in 1757 than in 1866, because Moltke knew that the head of the great Austrian column could not deploy as rapidly as the Prussian columns could be brought against it.

The fact that the battle of Prag justified the King's confidence in his troops, is to our mind the real proof of his greatness as a leader. It has been so much the custom to praise the "dazzling combinations" and "daring stratagems" of different generals that we are in danger of forgetting, if indeed we have not already forgotten, that all possible combinations in war are in themselves exceedingly simple—many times more so than in a game of chess; but that the extraordinary gift of being able so correctly to appreciate the resultant fighting power of such an extremely variable human machine as an Army, that the task set it is never beyond its power of execution, is the real test of generalship—the idea of turning an enemy's flank is so exceedingly crude that it occurs to even the youngest bugler; the risk to which the army, weakened by the turning detachment, is exposed is so great that it escapes even the heavenborn intuition of our war correspondents.

This central factor in the whole campaign, viz., that the strategy was primarily based on the quality of the weapon, does not however, in our opinion, receive sufficient attention in the Staff narrative; it is true that the King's confidence in his troops is repeatedly referred to, but the expressions are conventional, not to say common-place, and

the whole idea does not run as a connecting thread throughout the work; it is as if an engineer in criticising a light and airy girder construction omitted to call attention to the accurate knowledge of strength of materials displayed in its construction; and we regret it the more, because as far as the work was first designed we had hoped to find in it at last that firm bed-rock of carefully analysed material which has so long been wanting as a base for all intelligent military criticism.

The fighting which terminated the campaign deserves the closest study, and illustrates very curiously the difficulties which surround the application of even the most obvious principles of tactics on the battle-field.

Though the Prussian infantry had been trained above all others to fire discipline, yet, when the test for which all the training was to fit them arrived, they threw away all their advantages and deliberately went in with the bayonet alone. One can imagine the torrent of criticism with which our modern pressmen would have overwhelmed the King and his generals for their useless waste of human life, yet as a fact the error was inevitable, and to this day no one has been able practically to escape the same dilemma.

Everyone knew then as now that a successful bayonet charge is only the consequence of a previously acquired fire superiority, but no one had or has as yet made it clear how to get near enough to an enemy to obtain this fire superiority without committing the troops too far.

In his earlier regulations, the King has distinctly laid down that fire was to be withheld to effective range and then after a couple of volleys the troops were to press home with the bayonet; but the difficulty subsequently arose that in practice subordinate officers sometimes judged effective ranges much too liberally, and once halted, the line could not be induced to go further at all. Then the pendulum swung over to the other extreme, and, trusting that human nature would always assert itself in sufficient time, the bayonet was placed in the forefront alone, and this time the troops, or the great part of them, took the King at his word and were shot to pieces before they could get at the enemy at all.

It is worth while to draw a comparison between the fire they essayed to face and that of the present day, a comparison the official account completely overlooks.

The Austrians held a position of roughly one mile of front at the top of a gently sloping glacis 1,500 yards in width, and over this slope they could bring to bear 7,500 muskets with as many more in reserve, 42 heavy guns of position (18-pounders), and at least eighteen 3-pounder battalion guns. The case fire of a 3-pounder was more deadly than the fire of a Pom-Pom, and the 18-pounders took the same case as one of our 40-pounders, and 7,500 muskets at two rounds a minute gave at least as many bullets as a single rank of men with Lee-Metfords could discharge to-day; yet without a round of artillery preparation, a single line of Prussian infantry, without supports or reserves, went steadily up that hill and continued advancing until from 50 to 60 per cent. of several battalions had gone down.

Ultimately they were beaten, of course, and the whole plan of action deranged, but the subordinate leaders kept hold of their men, and on their own initiative continued the fight, striking in as opportunity offered, till sheer hard fighting had decided the result.

One looks in vain through the pages of the Official History of 1870 to find better examples of tactical co-operation, and our only conclusion is that there was nothing inherently vicious in the principles or training of the old line to justify the adverse criticisms to which it has been exposed in Prussia since Jena, a conclusion which is confirmed by our own military history from 1809 to 1857.

Social and Imperial Life of Great Britain. Vol. I., "War and Empire." By KENELEN D. COTES, M.A. London: Grant Richards. 1901.

This is a work of far more than average importance, characterised by great originality of thought and accuracy of expression, and it has the good fortune to appear at the psychological moment, for if ever this country needed to be aroused to the true ethical importance of war, and its influence on the moulding of national character, now is the time.

It is so many ages since the inhabitants of our sea-girt isle had direct personal knowledge of all that war entails, and its effect in originating and moulding those national characteristics of duty to the State and faithfulness to one's word in relations of social life, on which our commercial prosperity was originally founded, that as a nation we seem now to lack that hardness of character which alone can bring the present war to a conclusion; and even in those papers where one might hope to find the best defence of the course of action the obstinacy of the Boers has forced upon us, one looks in vain to find a recognition of the stern truth that the cruelest kindness is mistaken leniency in the prosecution of war.

Some twenty years ago Mr. J. R. Green wrote in the preface of his "History of the English People":—"It is the reproach of historians that they have too often turned history into a mere record of the butchery of men by their fellow-men. But war plays a small part in the real story of European nations, and in that of England its part is smaller than in any. The only war which has profoundly affected English society and English Government is the hundred years' war with France (1336-1431), and of that war the results were simply evil." This book has formed the text-book from which a whole generation of Englishmen has drawn its training in our national traditions, and Mr. Cotes' "War and Empire" is the revolt of common-sense and intelligence against so grave a fallacy.

He shows us war, considered in the abstract as it really is, the natural agency by which alone great empires are built up and maintained. It was not to trade and commerce that we owe the first impulses towards truth, honesty, and reliability, which form the basis of modern credit on which commerce depends.

Trade within the limits of a tribe or nation, which was not held together by the reality of outside danger, has everywhere and always degenerated into the most unrestricted struggle for the survival of the individual, bringing poverty and suffering to the weaker almost in precise proportion to the absence or presence of tangible danger from outside sources.

Where all men bear arms alike, it is dangerous to supply shoddy goods to your customer or drive hard bargains generally, as men along the Afghan frontier well know; but where the *pax Britannica* now reigns, the advantages of law and order are not altogether on the side of the poor, as the Indian *ryot* in the clutches of the money-lender too often discovers.

Generally, the history of social evolution is this: A tribe a little in advance of its neighbours settles in some fertile plain and begins to accumulate property, which attracts the cupidity of surrounding robbers; to defeat these robbers, the individuals of the richer tribe must combine, the strong aiding the weak, and both being absolutely true to their word and willing to die in defence of the interests of others. It is the need of constant watchfulness that the possession of coveted goods involves that lays the first foundation for mutual trust between man and man, and develops the instinct of self-sacrifice. The robber tribe, whose goods nobody desires, needs no watch or ward, for nobody cares to attack it; but in the settled tribe someone must watch whilst others

sleep, and when the attack comes some must sacrifice their lives if need be to give time for the others to rally ; and it is this need for watchfulness that gives rise to the first elementary instinct of law and the protection of property, for the goods of the watchers must not be stolen whilst they are on duty.

Gradually, as the tribe grows, trades and occupations begin to specialise ; the pick of the nation does the fighting, and the remainder takes to trading ; but the fighting men get the pick of the women, and the root cause of envy, hatred, and all uncharitableness takes possession of the rejected. It is now a struggle within the tribe itself for the most desirable of the women, and the race for wealth begins, in which the stay-at-home trader has all the advantages. The soldier returns from the front to find his women-kind seduced by the attractions which wealth can offer and his lands filched by unscrupulous relations ; and the caste becomes ever poorer and poorer.

Again, the robber tribes come down over the hills, and the nation stands or falls primarily by the amount of care it has devoted to the maintenance of the soldier's interests. If he has been allowed to sink in the social scale, and it has become evident to him that justice is at the mercy of the longest purse, his defence will be feeble and half-hearted, and the doom of the nation is assured.

Mr. Cotes traces this cycle of cause and effect from our earliest historical records, but one can see them in actual operation in the native States of India, the final catastrophe being only averted by the protecting power of the British *raj* ; and looking on at the game of international politics as it is now being played, one wonders sometimes whether greater Powers than the little native States may not be nearing a catastrophe which the British Government at any rate will be powerless to avert.

This line of investigation, however, has a very remarkable effect in redistributing the responsibility for war on different shoulders. To Mr. Green and his school it is always the big strong Power that brutally attacks its little weak neighbour, whereas, as everyone who knows anything of the secret history of Governments is aware, even when the first act of hostilities is committed by that side which is ultimately victorious, the real cause can be shown to have lain in the rottenness and corruption of the nation that goes under. Our own action at Copenhagen, where the weakness of the Danes constituted the gravest danger to us, or in the Sikh wars, though in this case the Sikhs actually fired first—not to mention the Transvaal—are cases in point. This, again, discredits the popular notion that wars being made by kings and statesmen and won by generals can be averted or lost through the same means. But if war, as we believe with Mr. Cotes, originates through a disturbance in the level of national morality, which causes the higher regions of pressure to rush down upon and fill up the lower as in ordinary atmospheric disturbances, then the responsibility is shifted from the shoulders of unfortunate men on to those of the Almighty God, who gave his creatures the natural law under which they are compelled to live, work, and have their being.

Most of our popular writers, repeating parrot-wise the history they learnt at their schools and colleges, appear to imagine that victory is primarily an affair of the latest modern weapons and correct tactics, and curiously it seems that Mr. Cotes himself is inclined to the same idea ; but the line of thought which his book suggests as a whole does not lead to this conclusion, neither does military history support it. It rather suggests that those nations whose standard of true morality is highest will have the best average of administration and supply, and tactics on the field of battle will be executed with greater self-sacrifice and greater exertion on the part of individuals ; and battles are decided not because the weapons and tactics are intrinsically superior, but because the standard of morality in the race being higher, weapons and

tactics are employed to better advantage ; which makes a very important difference, and leads to the ultimate conclusion that the arbitrament of the battle-field is God's final court of appeal, and fully justifies the customary invocation both nations address to the Almighty to decide between them.

We have dwelt upon this subject at this length because in no other English book published in the last century, or, indeed, in any other as far as our knowledge goes, has the attempt ever been made to place war—*i.e.*, the profession of the soldier—on a proper ethical plane. To the Germans the idea is common, though, again, no single writer brings forward the proof of the thought that lies behind his work with equal clearness. But the value of this book does not end here. Everyone who has attempted to trace in military history the cause of defeat is acquainted with the difficulty of finding the starting-point of prejudices in the troops, of misconceptions on the part of their leaders, and so forth, which have prevented their armies from developing their full efficiency on the field of battle. Even at the present day this research invariably carries one back to the middle ages, and critics fail in the validity of their conclusions almost in proportion to the date they select as the initial point of departure.

The average man has no time to spare for these investigations, and he owes a real debt of gratitude to Mr. Cotes for the summary of the progress of evolution in the art of war, which he has supplied in his fascinating pages.

It would be greatly in the interest of our national military education if the Royal Commission now about to assemble to report on this subject would recommend that Mr. Cotes' work should be used as a text-book for all military examinations, so that there might be some prospect of our young officers joining with that elementary grounding in the history of national evolution, a knowledge of which must precede their further study of the art of war.

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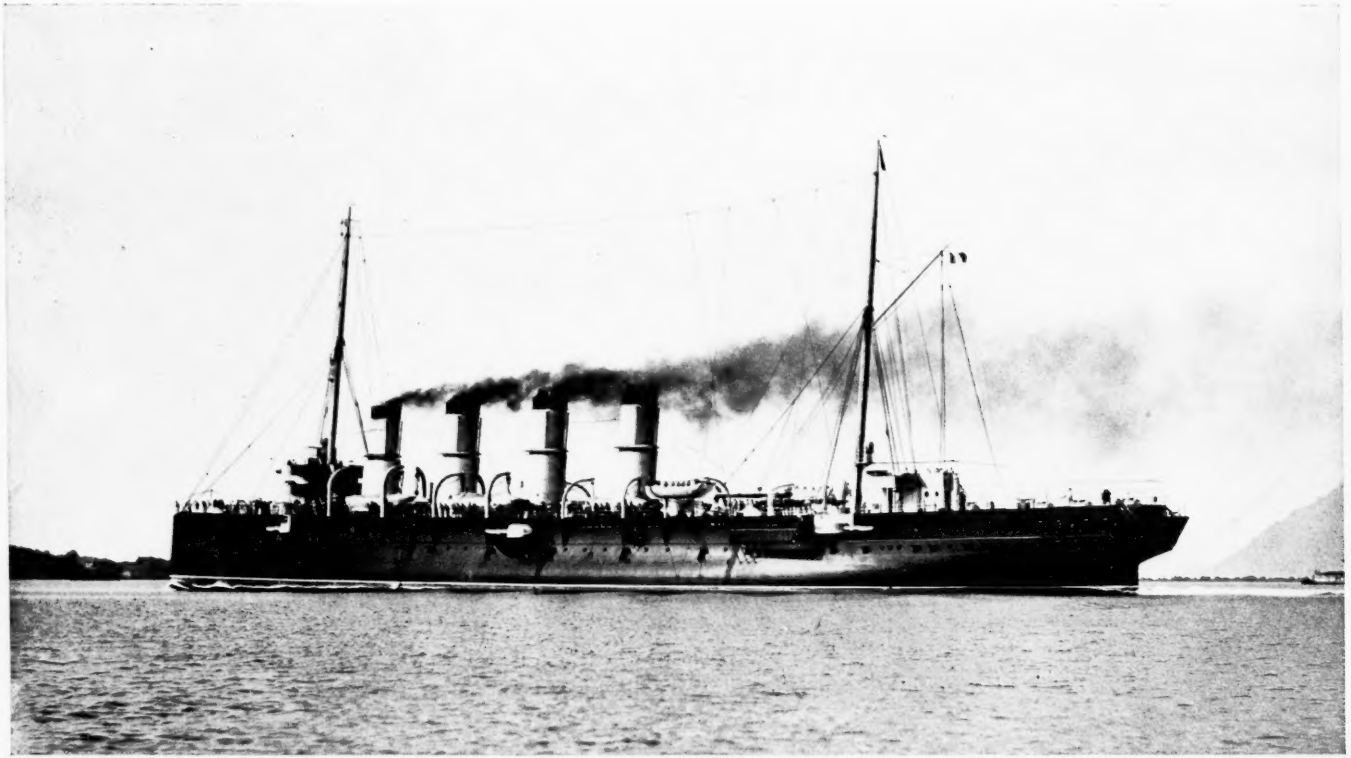

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